JOURNAL OF THE MALACOLOGICAL SOCIETY OF AUSTRALIA

NUMBERS 1 TO 10

MELBOURNE AND SYDNEY

1957 - 1966

MALACOLOGICAL SOCIETY OF AUSTRALIA
Victorian Branch

The Journal of the Malacological Society of Australia is a medium for the publication of scientific papers dealing with Mollusca and related topics, published annually by the Society.

Editors

Mrs. D. I. Hartley
1957-1959

Miss F. V. Murray
1960

Dr. D. F. McMichael
1961-1966

Acceptance of papers for this Journal is in the hands of the Council of the Malacological Society of Australia. All enquiries and manuscripts should be forwarded to the Hon. Secretary, Malacological Society of Australia, C/o The Australian Museum, College Street, Sydney, N.S.W.

TABLE OF CONTENTS

JOURNAL No. 4 (13th November, 1960)

JOURNAL No. 5 (13th November, 1961)

JOURNAL No. 6 (31st January, 1963)

JOURNAL No. 7 (6th December, 1966)

JOURNAL No. 8 (15th December, 1964)

JOURNAL No. 9 (28th January, 1966)

JOURNAL No. 10 (16th November, 1966)

THE MALACOLOGICAL SOCIETY OF AUSTRALIA

INDEX — JOURNALS NOS. 1-10

SURREY BEATTY & SONS, Printers,
Rickard Road, Chipping Norton, N.S.W.

602-7404

THE MALACOLOGICAL SOCIETY OF AUSTRALIA

1963

Patrons:

R. TUCKER ABBOTT, Ph.D.
JOYCE ALLAN, F.R.Z.S.
BERNARD C. COTTON, F.R.Z.S.
E. ALISON KAY, Ph.D.

Honorary Members:

A. W. B. POWELL, D.Sc.
RUDOLF BRUNNSCHWEILER, Ph.D.
EDMUND D. GILL, B.A., B.D., F.G.S.

Honorary Life Member:

Mrs. D. I. HARTLEY.

President:

DENZIL I. HARTLEY.

Hon. Secretary-Treasurer:

Mrs. D. I. HARTLEY.

Hon. Editor:

DONALD F. McMICHAEL, Ph.D.

Printed by K. A. Wood Pty. Ltd., 521 Kent Street, Sydney, Australia. Registered in Australia for Transmission by Post as a Book.

Published annually by the Malacological Society of Australia, and obtainable from the Secretary, 351 Glenferrie Road, Malvern, S.E.4, Victoria, Australia. Price: 16/- Australian Currency, or $1.80 U.S. Currency, or 13/- Sterling, postage included. Special rates for complete sets.

DATE OF PUBLICATION OF JOURNAL No. 6

The date of publication of Journal of the Malacological Society of Australia No. 6, as stated on the cover, 31st December, 1962, is incorrect. Owing to unavoidable delays the Journal was not published until the 31st January, 1963.

Errata slip.

Journal of the Malacological Society of Australia, No. 7, 6th December, 1963.

page 25.

Acknowledgements: The authors wish to express their thanks to Miss J. Hope Macpherson, of the National Museum of Victoria, who identified the specimens and elucidated the nomenclature; to Mr. A. M. Rowlatt, of the C.S.I.R.O. Animal Health Laboratory, for the photographs of Plates 2 and 3; and to Mr. W. McNutt, of the Microscopy Laboratory, University of Melbourne, for the photomicrograph of Plate 3.

CHARLES JOHN GABRIEL

1879-1963

Charles John Gabriel was born on 28th May, 1879, to Joseph and Elizabeth Lovatt Gabriel of Victoria Street, Abbotsford. He was the third child and first son of Joseph Gabriel, a pharmacist.

Joseph Gabriel was a man of many interests, including natural history and woodwork. A keen member of the Field Naturalists, he instilled an interest in natural history into his children and it was at his firm instigation that the young Charles, who enjoyed telling the story in later years, won his first reward for an exhibition of shells at the Field Naturalist Club Show when nine years of age, 1888.

He was proposed by his father and became a member of the Field Naturalist Club on June 19th, 1900, and his first paper, a check list of Marine Mollusca from Stony Point, was published in the Victorian Naturalist in April, 1908. In the same year, the first of a long series of joint papers with the late J. H. Gatliff appeared in the Proceedings of the Royal Society of Victoria. Gatliff, in collaboration with J. W. Pritchard, had published the catalogue of Victorian Marine Mollusca in the Proceedings of the Royal Society between 1896 and 1904 and Gatliff,

between the latter date and 1908, had published some additions. The Gatliff and Gabriel partnership was to describe many new species and continued to revise and add to the catalogue until Gatliff's death in 1934. After this, Gabriel continued to bring it up to date on his own.

The Gatliff-Gabriel partnership resulted in the description of 36 new species, 3 varieties and 2 genera. As well as a number of solo contributions, Gabriel was associated with B. C. Cotton, F. Chapman and J. Hope Macpherson in a number of papers.

He was appointed to the Staff of the National Museum as an honorary worker in 1933 when the late D. J. Mahony introduced the practice of giving eminent local workers the status and privileges of honorary association with the curatorial staff. Charles Gabriel more than justified his choice, as up to the time of his death he gave continuous benefit of his wide knowledge and material assistance to the Mollusca department.

A firm believer in the principle that type specimens should be housed in a museum and not a private collection, he presented all types in his collection to the museum. After this date he handed over all type material and representatives of new records on completion of each paper.

Charles Gabriel was not only a desk scientist but enjoyed collecting his own specimens, and particularly in his early years undertook extensive dredging in both Western Port and Port Phillip Bay. Only a few days before his death, he made a shore and land shell collecting trip to Eastern Victoria.

He was awarded the 1958 Natural History medallion for his contribution to the spread of interest in natural history. This was a long overdue honour which he had failed to get previously because his contribution to the cause of natural history has been on a person to person basis rather than by popular lectures and articles. At the time of his death, on the 19th June last, he had just completed a paper on new species of Victorian land shells and was working on additions to the catalogue of Marine Mollusca. His many systematic papers contain descriptions of five new genera, approximately one hundred and twenty species and six varieties.

J. HOPE MACPHERSON,
Curator of Molluscs,
National Museum of Victoria,
2nd October, 1963.

BIBLIOGRAPHY OF CHARLES J. GABRIEL

1908. Gabriel, C. J. *Vict. Nat.*, XXV, No. 3 (July), pp. 54-55. Marine Mollusca found near Stony Point, April, 1908.

Gatliff, J. H., & C. J. Gabriel. *Proc. Roy. Soc. Vict.*, XXI (n.s.), pt. 1 (Aug.), pp. 365-367, pl. XXI. On Some New Species of Victorian Marine Mollusca.

——— & ——— *ibid.*, pp. 368-391. Additions to and Revision of the Catalogue of Victorian Marine Mollusca.

1909. Gabriel, C. J. *Vict. Nat.*, XXVI, No. 2 (June), pp. 19-20. Excursion to Stony Point, Western Port. (List of Mollusca additional to previous.)

Gatliff, J. H., & C. J. Gabriel. *Proc. Roy. Soc. Vict.*, XXII (n.s.), pt. 1 (Sept.), pp. 35-36, pl. XIII. Description of a New Marine Shell of the genus *Larina* (?).

——— & ——— *ibid.*, pp. 37-46. Additions to the Catalogue of the Marine Shells of Victoria.

——— & ——— *Vict. Nat.*, XXVI, No. 8 (Dec.), pp. 117-118, pls. II, III. First record of the animal of *Voluta mammila* Gray with remarks thereon.

1910. ———& ——— *Proc. Roy. Soc. Vict.*, XXIII (n.s.), pt. 1 (Aug.), pp. 82-86, pls. XVIII, XIX. On Some New Species of Victorian Marine Mollusca.

———& ——— *ibid.*, pp. 87-98. Additions to the Catalogue of the Marine Shells of Victoria.

1911. Gabriel, C. J. *Vict. Nat.*, XXVIII, No. 5 (Sept.), pp. 96-98. Notes on Exotic Mollusca found at Coode Island, with Lists of Species.

Gatliff, J. H., & C. J. Gabriel. *Proc. Roy. Soc. Vict.*, XXIV (n.s.), pt. 1 (Sept.), pp. 187-192, pls. XLVI, XLVII. On Some New Species of Victorian Marine Mollusca.

———& ——— *ibid.*, pp. 193-200. Additions to and Alterations in the Catalogue of Victorian Marine Mollusca.

1912. ———& ——— *Vict. Nat.*, XXIX, No. 3 (July), pp. 46-48, pls. III, IV. On a New Variety (var. *Bakeri*) of the Marine Shell *Fasciolaria australasiae* Perry.

———& ——— *Proc. Roy. Soc. Vict.*, XXV (n.s.), pt. 1 (Aug.), pp. 167-168, pl. IX. On Some New Species of Victorian Marine Mollusca.

———& ——— *ibid.*, pp. 169-175. Additions to and Alterations in the Catalogue of Victorian Marine Mollusca.

1913. ———& ——— *ibid.*, XXVI (n.s.), pt. 1 (Sept.), pp. 67-70, pl. VIII. On Some New Species and Varieties of Victorian Marine Mollusca.

———& ——— *ibid.*, pp. 71-87. Additions to the Catalogue of the Marine Shells of Victoria.

1914. ———& ——— *Vict. Nat.*, XXX, No. 11 (Mar.), pp. 210-214, pl. II. List of Recent Victorian *Brachiopoda.*

Chapman, F., & C. J. Gabriel. *Proc. Roy. Soc. Vict.*, XXVI (n.s.), pt. II (Mar.), pp. 301-330, pls. XXIV, XXVIII. Description of New and Rare Fossils obtained by the Deep Boring in the Mallee. Pt. II. Mollusca.

Gatliff, J. H., & C. J. Gabriel. *Vict. Nat.*, XXXI, No. 5 (Sept.), pp. 82-84. Alterations in the Nomenclature of Some Victorian Marine Mollusca.

———& ——— *Proc. Roy. Soc. Vict.*, XXVII (n.s.), pt. I (Sept.), pp. 94-98, pls. XIV-XVI. On Some New Species of Victorian Marine Mollusca.

———& ——— *ibid.*, pp. 99-103. Additions to the Catalogue of the Marine Shells of Victoria.

1915. ———& ——— *Proc. Roy. Soc. Vict.*, XXVIII (n.s.), pt. I (Nov.), pp. 115-123, pls. XII, XIII. Notes on Some Victorian Species of *Teredo.*

1916. ———& ——— *ibid.*, XXIX (n.s.), pt. I (Oct.), pp. 104-105, pl. VII. Description of a New Genus and Two New Species of Victorian Marine Mollusca.

———& ——— *ibid.*, pp. 106-113. Additions to and Alterations in the Catalogue of the Marine Shells of Victoria.

1917. Chapman, F., & C. J. Gabriel. *ibid.*, XXX (n.s.), pt. I (Sept.), pp. 4-14. On a Shell-bed underlying Volcanic Tuff near Warrnambool, with Notes on the Age of the Deposit.

Gatliff, J. H., & C. J. Gabriel. *ibid.*, pp. 21-31, pl. III. Additions to and Alterations in the Catalogue of the Marine Shells of Victoria.

1921. ———& ——— *Proc. Malac. Soc. Lond.*, XIV, pts. V and VI (Oct.), p. 173. Text fig. Description of a New *Phasianella* (*P. tomlini*) from Western Australia.

1922. Gabriel, C. J. *Pals (Boys' Weekly)*, Vol. 2, No. 36 (Apr.), p. 847. The Young Collector. Sea Shells.

Gatliff, J. H., & C. J. Gabriel. *Proc. Roy. Soc. Vict.*, XXXIV (n.s.), pt. II (May), pp. 128-161. Additions to and Alterations in the Catalogue of Victorian Marine Mollusca.

1923. ———— & ———— *Vict. Nat.*, XL, No. 1 (May), p. 10, pl. II. On a New Marine Bi-Valve Shell, *Hemidonax chapmani* sp. nov.

Chapman, F., & C. J. Gabriel. *Proc. Roy. Soc. Vict.*, XXXVI (n.s.), pt. I (Dec.), pp. 22-40, pls. 1-111. A Revision and Description of the Australian Tertiary *Patellidae, Patelloididae, Cocculinidae* and *Fissurellidae.*

1925. Gabriel, C. J. *Vict. Nat.*, XLII, No. 8 (Dec.), p. 207. Land Mollusca New for Victoria.

1926. Gatliff, J. H., & C. J. Gabriel. *Proc. Roy. Soc. Vict.*, XXXVIII (n.s.), (July), pp. 88-94. Additions to the Catalogue of Victorian Marine Mollusca.

1929. Gabriel, C. J. *Vict. Nat.*, XLVI, No. 6 (Oct.), pp. 130-134. Text figs. Report on Land Shells from Cann River, Victoria.

1930. ———— *Proc. Roy. Soc. Vict.*, XLIII (n.s.), pt. I (Sept.), pp. 62-88, pls. II, III. Catalogue of the Land Shells of Victoria.

1931. Gatliff, J. H., & C. J. Gabriel. *ibid.*, pt. II (Feb.), pp. 202-232. Additions to and Alterations in the Catalogue of Victorian Marine Mollusca.

1932. Cotton, B. C., & C. J. Gabriel. *ibid.*, XLIV (n.s.), pt. II (Apr.), pp. 155-160, pl. XVI. Australian *Unionidae.*

Gabriel, C. J. *Vict. Nat.*, XLIX, No. 1 (May), p. 21. Fresh Water Mussels (Beechworth Excursion, Easter, 1932).

1933. ———— *Vict. Nat.*, L, No. 2 (June), p. 48. Text fig. The Victorian "Umbrella Shell", *Umbraculum corticale.* Tate.

1934. ———— *Mem. Nat. Mus. Melb.*, No. 8 (Sept.), p. 157, pl. XVIII. Figs. 1-3. *Thalassohelix translucens,* a New Victorian Land Shell.

1936. ———— *Victorian Sea Shells.* (F.N.C.V. Handbook, pp. 1-68, pls. 1-6. Text figs.)

1937. ———— *Vict. Nat.*, LIII, No. 10 (Feb.), pp. 171-172. Text fig. *Humphreyia strangei* A. Adams: A Peculiar Bivalve Shell.

1939. ———— *Mem. Nat. Mus. Melb.*, No. 11 (Nov.), pp. 100-139, pls. I-IV. The Fresh Water Mollusca of Victoria.

1947. ———— *ibid.*, No. 15 (Oct.), pp. 109-125. Additions to and alterations in the Catalogue of the Land Shells of Victoria (including descriptions of new species).

Gabriel, C. J., & J. H. Macpherson. *ibid.*, pp. 158-167. A preliminary report on the Biology and Ecology of the Snowy River area in north-eastern Victoria. Mollusca.

1956. Gabriel, C. J. *ibid.*, No. 22, pt. 4 (July), pp. 1-15, Mollusca from South East of King Island, Bass Strait.

1962. ———— *ibid.*, No. 25 (May), pp. 177-210. Additions to the Marine Molluscan Fauna of South Eastern Australia.

Macpherson, J. H., & C. J. Gabriel. *Marine Mollusca of Victoria,* pp. i-xv, 1-475, 486 text figs. Melbourne University Press.

C. J. Gabriel & J. H. Macpherson. In manuscript. Additions to and Alterations in the Catalogue of the Land Shells of Victoria (including descriptions of New Species).

THE AGE AND ECOLOGY OF FOSSIL MOLLUSCA FROM RED BLUFF, SANDRINGHAM, VICTORIA

By EDMUND D. GILL*

Plate 1, Figs. 1-5.

At Red Bluff, Sandringham, on the east coast of Port Phillip, there is a high cliff of Tertiary rocks. At the base of the cliff is ironstone up to 15 feet in vertical thickness, above which is up to 85 feet of tinted clayey sands (Gill 1959, p. 169). The resistant ironstone forms a platform that juts out into the bay, while the softer sediments above are grooved with the deep rillways of badlands erosion. The section at Red Bluff is the type section for the Sandringham Sands Formation, the ironstone at the base being the Black Rock Member, and the clayey sands above the Red Bluff Member.

FOSSILS FROM THE MIOCENE SEA

The sediments that were later turned into ironstone were often coarse and not particularly well sorted. They were sandy in character, and the marine shells in them were often washed together into pockets. The remains of a tree trunk were also found at Red Bluff in the ironstone. This probably was ferried down a local river, became water logged in the sea, and sank. All these features suggest a shallow water environment. The ecology was probably not very different from the present one in that area, except that an open bay was probably there without the bay bar that characterises Port Phillip now.

After the deposition of these marine sediments and their fossils, the sea retreated, and they were lateritized under a subtropical climate with alternating wet and dry seasons. The ironstone is thus part of a fossil soil, and this is why it transgresses beds of different ages. For example, Balcombian beds at Frankston have been turned to ironstone, ? Bairnsdalian beds at Royal Park, and Cheltenhamian beds at Beaumaris. The severe leaching of the sediments during the formation of this ironstone dissolved away all the molluscan shells leaving only casts and moulds. Many ironstones in Victoria and contiguous states have been examined, and it has been noted that (1) no ferruginization of lateritic type (sense of Buchanan, e.g., see Gill, 1953) has affected rocks younger than uppermost Miocene (Cheltenhamian), and (2) the areas of lateritized rocks and of the Lower Pliocene marine beds are mutually exclusive. The justly famous molluscan Lower Pliocene faunas of the Lakes Entrance and Hamilton districts would not have been so beautifully preserved if the rocks had been lateritized. From the foregoing and other evidence it is inferred that the lateritization took place in Lower Pliocene time.

RESTORATION OF MOLLUSCA FROM RED BLUFF

Space scientists from the United States were in Melbourne recently making casts of australites, and some of the very fine grained plastic used by them was employed to restore the molluscs from Red Bluff existing only as casts and moulds. Plate 1, figures 1-2, show some of these restored specimens. As the ironstone at Red Bluff is part of a type section it is very desirable to determine its age accurately if possible. Foraminifera have been used very successfully for determining the age of Lower and Middle Tertiary formations, but in the Upper Tertiary (later than Bairnsdalian) they have not so far been successfully used. However,

* National Museum of Victoria, Melbourne.

mollusca have been shown by R. W. T. Wilkins (1962, 1963) to be useful for determining the age of Upper Tertiary formations in S.E. Australia. Molluscs are here used for determining the age of the ironstone at Red Bluff.

MOLLUSCS FOR CHRONOLOGY

There are many ways in which molluscs can be studied. Living species may be studied and their variations noted over their geographic range. In such a study the factor of time is neglected. Nevertheless, such studies are important because it is often not realized what a great variation there is in some species from place to place. For example, *Placamen placidum* from New South Wales is not the same as that from Tasmania. It is all too easy for us to accept the local variation as the standard for a species. The type of *Placamen placidum* came from Tasmania (although the exact site is not known), so the Tasmanian variant is *P. placidum* sensu stricto. The variations in other places may be geographical races or clinal variants. Some species gradually merge into others; they have their own modes of variation but the limits of the two species partly overlap.

Then again molluscs may be studied by following not only the geographical variations (changes in space) but also the changes through the fossil record (changes in time). To trace the evolution of a molluscan genus in this way not only elucidates its biology but also makes available a dating mechanism because the changes are a function of time. The writer was asked by an international organization to study the boundary between the Tertiary and the Ice Age (the Plio-Pleistocene boundary) in Australia, so evidence has been collected for some years of both the evolving forms of life over this time and the changing environments in which they lived. It has been found that studying the molluscs evolutionally, tracing the changes in both time and space, has thrown a good deal of light on the problem. Two of these molluscan studies will be mentioned because they help to provide the age of the ironstone at Red Bluff.

THE *PLACAMEN* STORY

On three different occasions the writer has been requested to work out whether the living *Placamen placidum* (formerly called *roboratum*) and the fossil *P. subroboratum* are one species or two. All the living and fossil populations of these *Placamen* that were available were studied, Mrs. E. M. Davies carrying out long series of careful measurements to make possible an objective statistical check of the differences. It was

---

PLATE 1

Fig. 1: *Zenatiopsis* sp. nov. Cast in plastic of external mould from ironstone at Red Bluff, Victoria. Note typical growth lines. P 22612.

Fig. 2: *Placamen* sp. nov. Cast of external mould from ironstone at Red Bluff. Note typical ribs and the rounded outline of this species. P 22610.

Fig. 3-4: *Zenatiopsis* sp. nov. The steinkern of paired valves viewed to show the left valve and right valve respectively. The cast of the hinge structures has not been figured. P 22613.

Fig. 5: *Zenatiopsis* sp. nov. A left valve (which is more diagnostic than a right valve) of the new species from Muddy Creek, west of Hamilton, Victoria. Note the similar width and direction of the internal rib between this and the Red Bluff specimen. P 21898.

N.B.: Numbers are registered numbers in the palaeontological collection of the National Museum of Victoria. Figures 1-4 are natural size, while figure 5 is x 1.5 approx.

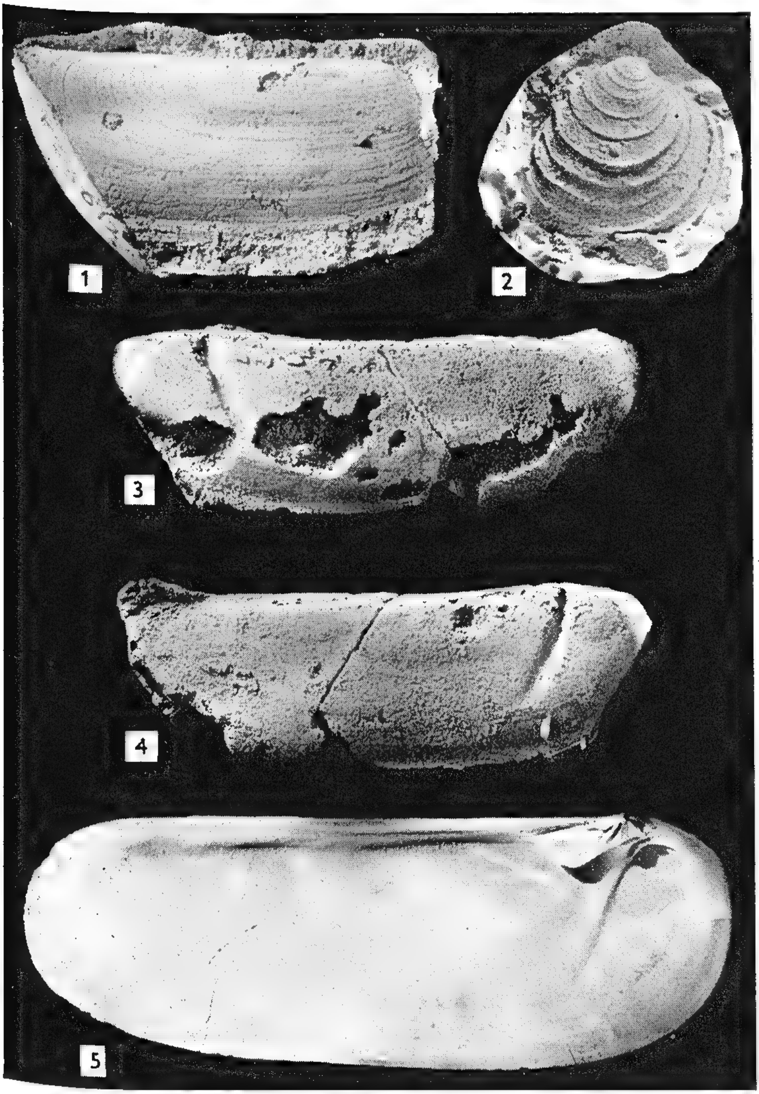


PLATE 1

discovered that the populations are very variable in both space and time, but that *P. subroboratum* is distinct from the living *placidum*, especially with respect to the flare in the posterior margin of the shell of the former species. These molluscs are also very variable in their growth stages. For example, the young of *P. subroboratum* are very like the adults of an earlier Miocene species (not yet described—Gill, 1962, p. 265) which does not have the flared posterior shell margin. The great variability is probably what has led people to doubt whether *placidum* and *subroboratum* are distinct species. One result of it is that a single specimen cannot always be determined, but if a random sample of an adult population (say six specimens) is viewed, there is never any doubt.

The new species of *Placamen* is limited to the Miocene (becoming extinct at the end of Cheltenhamian time), while *P. subroboratum* characterizes the Lower Pliocene (Kalimnan). The living *P. placidum* is known from the late Pliocene (Maretimo Member) to the present. Thus the species of *Placamen* can be used for dividing the Miocene from the Pliocene. Although *Placamen sp. nov.* can be used to define the top of the Cheltenhamian stage (uppermost Miocene), it cannot be used to define the bottom because it extends back into the Mitchellian and perhaps earlier still.

THE *ZENATIOPSIS* STORY

The Zenatiinae are a subfamily of unusual mactrid molluscs that are not well known because they do not occur in the vast numbers in which *Placamen* appears, and because they are limited to particular facies in particular latitudes. The genus *Zenatiopsis* has a long evolutionary history, being known from the Oligocene to the Quaternary. The zenatiins are very conservative in shell structure, so that living ones do not look very different from ones that lived many millions of years ago. They changed little in either time or space. However, there are small but important and dependable features by which a succession of species may be recognized. The well known fossil *Zenatiopsis angustata*, described many years ago by Professor Tate, is the species that lived through much of the Miocene Period. At about the beginning of the Cheltenhamian Stage (uppermost Miocene), *Z. angustata* became extinct and a new species (described in Gill and Darragh, 1963) took its place. These two species become more alike as they approach one another in time, and so it is inferred that *angustata* evolved into the new species.

THE RED BLUFF PROBLEM

Some have expressed doubt as to whether it would ever be possible to solve the problem of the exact age of the Red Bluff ironstone because there are only a few molluscs there, and they exist only as casts and moulds that are often difficult to determine. Modern casting materials make it possible to restore the appearance of the original shell, while the evolutionary study of the molluscs (studying all available populations) makes it possible to fix the age of the deposit. The *Placamen* is of the new species limited to the Miocene, i.e. it is Cheltenhamian or older. On the other hand, the *Zenatiopsis* belongs to the species that is Cheltenhamian or younger. With the lower age limit set by *Zenatiopsis sp. nov.*, and the upper age limit set by *Placamen sp. nov.*, it is possible to solve the problem of the age of the ironstone at Red Bluff and to say that it is Cheltenhamian. It is of the same age as the beds in the cliff at Beaumaris above the nodule bed (Singleton 1941, Gill 1957). The evolutionary and ecological study of molluscs can solve many problems of taxonomy and stratigraphy, up to the standard of present knowledge. The Red Bluff

ironstone can be dated by only two molluscs because their evolutionary history and the range of variation among their populations is known in detail.

PLIOCENE LAGOONS AND DELTA

After the bed with the marine molluscs was laid down in shallow water at Red Bluff, the sea retreated, and a monsoonal type climate lateritized the sediments giving the ironstone we know today. Then the sea advanced again so that lagoons were formed along a sandy coast, for above the ironstone is a carbonaceous bed a foot or so thick that has yielded the pollen of three species of beech trees (*Nothofagus*), a species of eucalypt, the spores of tree ferns (*Cyathea*) and the skeletons of a species of marine hystrichosphaerids. The carbonaceous nature of the sediments, and the mixture of terrestrial and marine forms, suggest the deposit is a lagoonal one. Similar deposits are known in other places, including Hampton and Mentone. The 80 feet or so of clayey sands above the carbonaceous bed are interpreted as an ancient river delta. The Great Dividing Range was being built, and the sediments eroded from the uplifted land spread out to form a great delta across the area on which Melbourne now stands. No molluscs have been found in these sediments. Fossil snails have been sought assiduously (but without result), for these molluscs can throw light on both time and climate.

REFERENCES

GILL, E. D., 1950, Nomenclature of certain Tertiary beds near Melbourne, Victoria. *Proc. Roy. Soc. Vict.*, 62:165-171.

———, 1953, Buckshot gravel as a time and climate indicator. *Vict. Nat.*, 70:72-74.

———, 1957, The stratigraphical occurrence and palaeoecology of some Australian Tertiary marsupials. *Mem. Nat. Mus. Vict.*, 21:135-203.

———, 1962, Darwin and dating the past. *Evolution of Living organisms.* (Royal Society of Victoria Centenary Volume), pp. 260-268. Melbourne University Press.

GILL, E. D., and DARRAGH, T. A., 1963, Evolution of the Zenatiinae (Mactridae, Lamellibranchiata). *Proc. Roy. Soc. Vict.*, 77 (In press).

SINGLETON, F. A., 1941, The Tertiary geology of Australia. *Proc. Roy. Soc. Vict.*, 53:1-135.

WILKINS, R. W. T., 1962, *Miltha* in the South-Eastern Australian Tertiary. *J. Malac. Soc. Aust.*, 6:43-48.

———, 1963, The relationships of the Mitchellian, Cheltenhamian and Kalimnan Stages in the Australian Tertiary. *Proc. Roy. Soc. Vict.*, 76:39-59.

DESCRIPTIONS OF AUSTRALIAN EOLIDACEA (MOLLUSCA: OPISTHOBRANCHIA)

1. THE GENERA *CATRIONA* AND *HERVIELLA*

By ROBERT BURN *

Text figures 1-15

SUMMARY

Catriona catachroma and *Herviella claror* spp. nov. are described from the south-eastern Australian fauna together with a further description of *C. viridiana* Burn (1962). *Catriona,* a genus of the family Cuthonidae, comprises two somewhat differing units, here distinguished as *Catriona* s.s. and *Eurycatriona* subgen. nov. Marcus (1957, 1958, 1960) has described species of *Catriona* with characters which would place some in Cuthoninae and others in Tergipedinae as at present defined, thus necessitating revision of the subfamily classification. The absence (Cuthoninae) or presence (Tergipedinae) of a penial stylet offers a convenient system after re-organization of genera. *Herviella,* a genus of the family Favorinidae, is a new record for the Australian Opisthobranchia.

INTRODUCTION

The Eolidacea are a fairly well known group of opisthobranch molluscs throughout the world seas, but in Australia it is only in recent years that any serious research has been undertaken and the results made available in published form. The writer in three papers (1957, 1961, 1962) has described a number of species from the south-eastern Australian coastline and to these a further two new species, *Catriona catachroma* and *Herviella claror,* are here added. A more detailed description of *Catriona viridiana* Burn (1962) is also given, based on more material than the original unique type.

The material examined for this research has been deposited in either the National Museum of Victoria, Melbourne (N.M.V.), or the Australian Museum, Sydney (A.M.), depending upon the State of origin of the material. All material has been collected by the writer.

The writer wishes to thank in particular the Trustees of the Science and Industry Endowment Fund, C.S.I.R.O. for a grant in aid of research on the Australian opisthobranchs. This paper is part of a comprehensive study of the Opisthobranchia of Australia being undertaken by the writer.

SYSTEMATIC SECTION

ORDER NUDIBRANCHIA
SUBORDER EOLIDACEA
SUPERFAMILY ACLEIOPROCTA
FAMILY CUTHONIDAE

The family Cuthonidae is still unsatisfactorily known with regard to the delimitation of genera. Even the division of the family into two subfamilies (Odhner, 1939: 75) based upon the one or two rows of cerata (Tergipedinae) or three and more (Cuthoninae) in the right liver, is no longer acceptable. For example, the genus *Catriona* which is classified as belonging to the Cuthoninae (Odhner, 1939: 53), also has

* 3 Nantes Street, Newtown, Geelong, Victoria.

species with two rows of cerata in the right liver, *C. perca* and *C. susa*, and one row, *C. tina* Marcus (1958: 45; 1960a: 916; 1957: 459). Thus if the number of rows of cerata in the right liver is utilized for subfamily division, *Catriona* will form two genera, one classified among the Cuthoninae, the other among the Tergipedinae. It is therefore very necessary to find some other basis for subfamily division, so that the natural groupings of genera are not lost in artificial classifications.

Odhner (1939: 69) has already emphasised the importance of the genital organs for the classification of the family Cuthonidae and with the recent additions to our knowledge of Cuthonid genera, one characteristic stands out as suitable for the division of the family into two. This is the absence (Cuthoninae) or presence (Tergipedinae) of a penial stylet in the form of a cuticular hollow spine. A re-arrangement of genera to suit this division results in the Cuthoninae having *Cuthona, Precuthona, Myja, Ennoia, Narraeolida, Cuthonella, Piseinotecus* and *Nurja*. To the Tergipedinae belong *Catriona, Subcuthona, Embletonia, Tenellia* and *Tergipes*. Parallel lines of development of the liver branchings are evident in the reconstituted subfamilies.

Genus *CATRIONA* Winckworth (1941: 148).

As Marcus (1957: 461) points out, species with one row of cerata in the right liver cannot be excluded from *Catriona*, although as envisaged by Odhner (1939: 53) there are at least three rows. However, with the addition of species with one and two rows in the right liver (see Family discussion) plus *C. pupillae* Baba (1961: 122) the genus has been greatly widened, so much so that there is now strong justification for dividing it into two distinctive groups, perhaps worthy of generic rank themselves. A brief analysis of the species attributed to the genus, extracted from Marcus (1958: 49-52), reveals that the majority of species do not agree as closely with the type of the genus, *C. aurantia* (Alder and Hancock, 1842; Odhner, 1939: 70, 74, fig. 41) as perhaps they should. *Catriona* as based on *C. aurantia* should contain species in which (i) the radular teeth are very short, broad, concave anteriorly with a receded cusp and prominent denticles with more than one smaller denticle between; and in the genital organs, (ii) a large broadly oval penial gland, (iii) a short straight penial stylet and (iv) a long slender spermatheca. Added to these but possibly of less importance are the facts that the right liver has a raised pad with the cerata in rows upon it (*C. maua* Marcus, 1960b: 178, fig. 74) and that the denticles of the masticatory border of the jaws are composed of bundles of fine bristles (loc. cit.: 179, fig. 76).

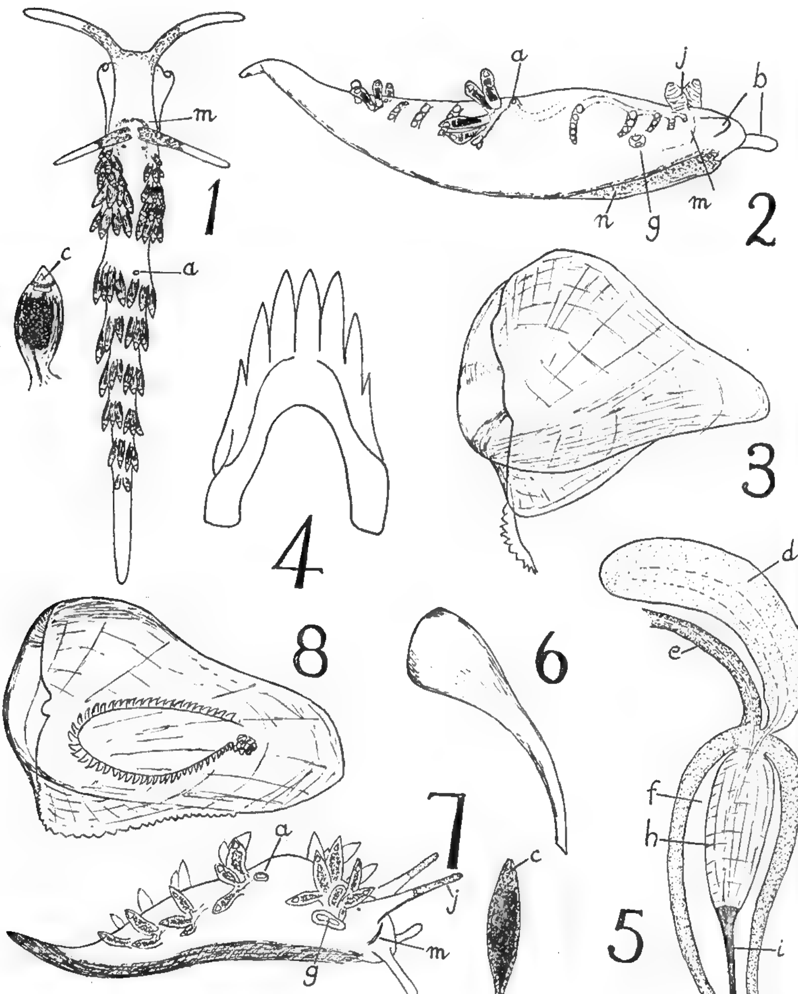
In contrast to these characteristics, the majority of the species have (i) a narrow to broad, anteriorly convex radular tooth with the cusp the same length or very little shorter than the denticles which have not more than one intermediate smaller denticle, (ii) an elongate oval penial gland, (iii) a long curved penial stylet and (iv) a short stalked pyriform or spherical spermatheca. The cerata arise from separate rows in the right liver and the denticles of the masticatory border are coarsely pointed. The species selected as typical of the majority group is *C. viridis* (Forbes, 1840; Odhner, 1939: 72-74, fig. 37-40).

Such is the weight of these differences that I propose to create a new subgenus within *Catriona* for the species grouped around *C. viridis* which becomes the type species. The new subgenus proposed is *Eurycatriona*, the prefix "eury" meaning "wide" to indicate the widespread distribution of species throughout the world seas. A synonym of *Eurycatriona* is *Montagua* Fleming (1822; O'Donoghue, 1929: 743) whose type species, *Doris coerulea* Montagu (1804; O'Donoghue, loc. cit.), can be with certainty assigned to *Catriona* (Marcus, 1955: 173). However, this name is preoccupied by *Montagua* Leach, 1814.

As now understood, *Catriona* and its subgenera may be diagnosed as follows:

Catriona. Acleioproct Eolidacea with a uniseriate radula and a denticulate masticatory border of the jaws; with simple, annulate or perfoliate rhinophores and rounded or angled foot corners; with penial gland and penial stylet; cerata in single rows.

Catriona (*Catriona*). Radular teeth concave anteriorly, cusp receded, denticles prominent with a number of smaller secondary denticles between. Denticles of masticatory border bundles of fine bristles. Penial stylet short, straight. Spermatheca long, slender. Right liver with raised pad bearing 3-4 rows of cerata.



Figures 1 to 8

Catriona (*Eurycatriona*). Radular teeth convex anteriorly, cusp same length or shorter than denticles, at most one smaller secondary denticle between. Denticles of masticatory border coarsely pointed or rounded. Penial stylet long, curved. Spermatheca short, pyriform or spherical. Right liver with one to five rows of cerata.

The two species described below belong to *Eurycatriona*.

Catriona (*Eurycatriona*) *catachroma* sp. nov.

Figures 1-6

Material examined: Point Danger, Torquay, Victoria, 144° 19′ East 38° 20′ South; 2 specimens, 10 December 1961, N.M.V. reg. no. F23,443 (holotype) and F23,444 (paratype).

Habitat: Near to one another on brown algae tips in rock channel at low tide.

Description: Alive both specimens measured about 10 mm. in length. Preserved the larger (holotype) is 5.5 mm. long and with the cerata, 2 mm. high and wide. The sole is medianly folded, 0.3 mm. wide. The cerata are up to 1 mm. in length. The living slugs were palest pink suffused with cream, the upper parts of the rhinophores and tentacles yellow, their bases orange. Cerata transparent, digestive glands dull grey-green, cnidosacs cream; surface everywhere speckled with minute brilliant blue dots, the middle part of the anterior side with a heavy dusting of white, the lot surmounted by a large yellow cap. The eyes are black and the jaws show through the head as a greyish mass (Fig. 1-2, *m*). Preserved, the whole coloration is dull pink.

Head narrow; rhinophores tapering, somewhat wrinkled; tentacles cylindrical, curved laterally. Foot corners rounded, sole wider than head anteriorly, tail very long and narrow, tip rounded, as preserved turned up. Cerata (Fig. 1) short and stout, cnidosacs (*c*) about one-quarter length. The right liver and its left-side counterpart have five simple rows of cerata, from the front containing at most 3, 4, 5, 6, 7 cerata. The posterior liver has five or six rows each side, the first two with 4 cerata, the second two with 3, then a short row of 2 and finally a single ceras.

The genital aperture (Fig. 2, *g*) with contiguous openings lies below and behind the third right row of cerata. The anus (Fig. 1-2, *a*) is dorsal to the first row of the posterior liver on the right side.

The yellowish 0.8 mm. long jaws (Fig. 3), strengthened anteriorly and ventrally, are trigonal like those of *C. foliata* (Forbes and Goodsir, 1839; Odhner, 1939: 75, fig. 43, ii) but more erect anteriorly. The masticatory borders are short and bear 9-10 generally pointed broad denticles. The colourless radula contains 30 teeth (Fig. 5), each with the cusp only as long as the flanking denticles. On each side of the cusp, two large and one small much lower denticles.

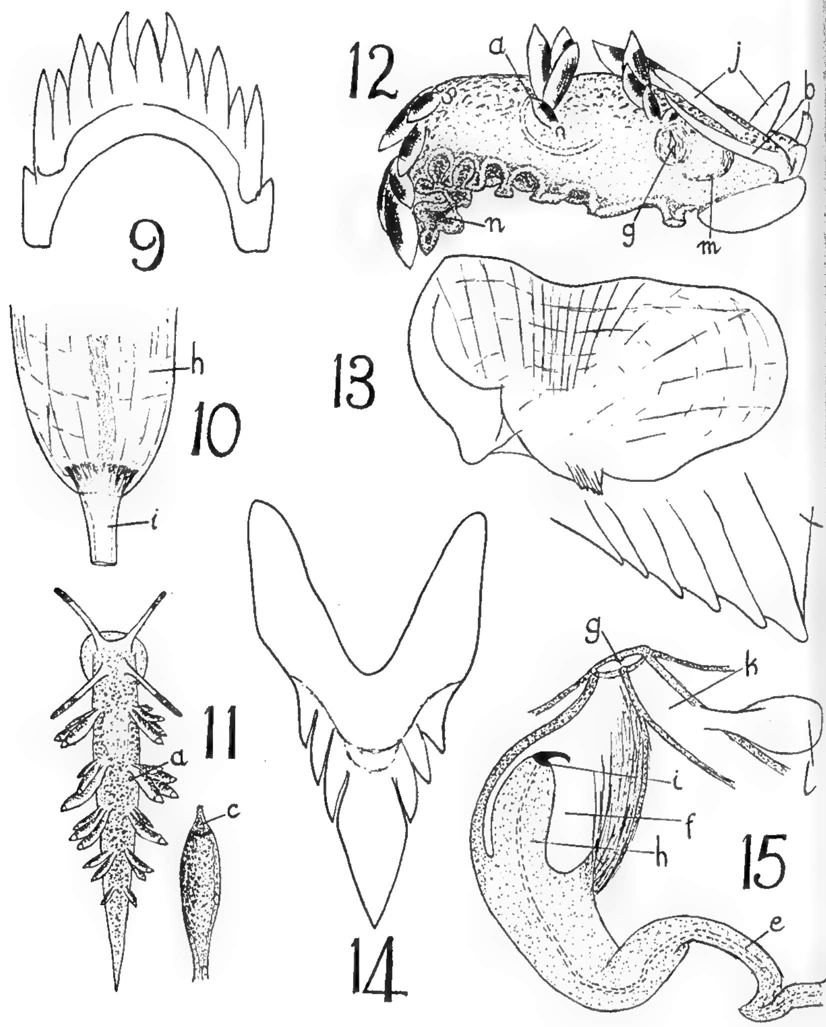
The fusiform penis (Fig. 5, *h*) is tipped by a very long slender curved amber penial stylet, 0.3 mm. long (*i*, Fig. 6). An elongate sausage-like penial gland (*d*) enters the base of the penis beside the male efferent duct (*e*).

Discussion: *C. catachroma* need only be compared with species having four or five rows of cerata in the right liver. Species with four rows are numerous but only one, *C. nigricolora* (Baba, 1955: 29,52, pl. 15, fig. 41, text fig. 46-47) has as few as three denticles each side of the cusp in the radular teeth. *C. nigricolora* is distinguished by a receded cusp on much broader radular teeth, 30 denticles on the jaw masticatory border and the black body and cerata colour.

Species with five rows are not common, the best characterized being the type of *Eurycatriona*, *C. viridis* (Forbes, 1840; Odhner, 1939: 70, 72-74, fig. 37-40) from northern Europe. From the new species, *C.*

viridis differs in the longer jaws and raking masticatory border denticles, the 5-6 denticles each side of the cusp in the radular teeth and the shorter penial stylet. The disposition of the liver rows, genital apertures and anus, together with the numbers of cerata in the rows, is practically identical in *C. catachroma* and *C. viridis*.

The specific name is derived from the Greek kata chroma—signifying "down colour" or "to turn very pale", in apt allusion to the living coloration.



Figures 9 to 15

Catriona (Eurycatriona) viridiana Burn

Figures 7-10

Catriona viridiana Burn, 1962:111-112, fig. 13. Torquay, Victoria.

Material examined: Point Danger, Torquay, Victoria; 1 specimen, 6 September 1959, N.M.V. reg no. F23,445; 2 specimens, 31 December 1959, N.M.V. reg. no. F23,446; 1 specimen, 5 March 1960, N.M.V. reg. no. F23,447; 5 specimens, 12 November 1961, N.M.V. reg. no. F23,448.

Habitat: More often than not the specimens are taken on algal tips in rock pools and channels at low tide level. The holotype was found under a stone (loc. cit.: 112) while another was found on the green alga, *Caulerpa scalpelliformis*, with which its colour blended well.

Description: Living specimens do not exceed 8 mm. in length; preserved the largest specimen is 3.3 mm. long, 1.4 mm. wide and with the cerata, 1.9 mm. high. Sole of foot broad with narrow margins, at widest 1 mm. Cerata up to 0.6 mm. high and 0.4 mm. diameter. Alive, the body-colour is palest greenish-yellow and the digestive glands green brown. In alcohol, the animals are wholly dull orange.

Head narrow; rhinophores (Fig. 7, *j*) proximally adjoining, long and tapering to a fine rounded point; tentacles short, curved forward, wider at ends. Foot as wide as head, corners rounded; tail short, tip rounded. Cerata short fusiform, cnidosacs (*c*) small, about one-fifth of length. Right liver with three simple rows, at most respectively with 3, 4 and 5 cerata; behind are four rows with 5, 4, 4, 3 cerata.

Genital apertures (*g*) contiguous, lateral to second row of right liver. The anus (*a*) is dorsal to the first ceras of the right side posterior liver first row.

The pale horn 0.6 mm. long jaws (Fig. 8), strengthened in front, are elongate pyriform. Masticatory borders with 30-40 rounded denticles of varying sizes, the foremost smallest and pointed. The pale yellow radula has 22 teeth in the straight dorsal limb, 30 in the curved ventral limb and about six more heaped together in an ascus-like bunch as in *Capellinia conicla* Marcus (1958: 43, fig. 76). The teeth (Fig. 9) are broader than long, each with a receded cusp and five alternately large and small denticles each side.

The round-ended penis (Fig. 10, *h*) bears a short straight brown stylet (*i*), the base of which is sunken in the tip of the penis. The stylet appeared to be broken in the specimen examined. An elongate oval penial gland surmounts the penial base, its connection is through a narrow duct.

Discussion: Species with three rows of cerata in the right liver and 4-5 denticles each side of the cusp in the radula form a large section of *Catriona*. The Japanese *C. venusta, C. anulata* and *C. pinnifera* (Baba, 1949: 98-100, 174-175, pl. 41-42), *C. ornata* (Baba, 1937; 1955: 27-28, pl. 14), *C. signifera* and *C. purpureoanulata* Baba (1961: 369-370, pl. 14-15) all have these characteristics in common. All except *C. venusta* are distinguished by having a longer than wide radular tooth, thus not conforming with *C. viridiana*. Together with *C. venusta,* all have different coloration to *C. viridiana*. The South African *C. speciosa* Macnae (1954: 3-6, pl. 1, fig. 1, text fig. 1-3) which is almost identical with *C. venusta* in size, liver branching, radular teeth and coloration, is separated from *C. viridiana* by its coloration and small number of large denticles on the masticatory borders.

SUPERFAMILY CLEIOPROCTA
FAMILY FAVORINIDAE
SUBFAMILY FAVORININAE
Genus *HERVIELLA* Baba (1949: 107, 180)

This genus is restricted to species of Favorinidae with a single oblique row of cerata set in single file (Favorininae) in the right liver. The anus emerges behind the second row on the right side, that is behind the first row of the posterior liver on the right side and being in the cleioproct position (Odhner, 1939: 50). The foot corners are rounded, the jaws have a prominent knob on the anterior edge and a small number of denticles on the masticatory borders, and the radular teeth are prominently cuspidate with 3-5 lateral denticles. The genital organs have a penial stylet in two species at least.

Hitherto two species belonged to the genus, the type *H. yatsui* (Baba, 1930: 121, pl. 4, fig. 4, text fig. 3; 1949: 107-108, 180-181, pl. 47, text fig. 145-146) and *H. affinis* Baba (1960: 303-304, fig. 1). Both from Japan and of similar dimensions, the two species are separated by details of the jaws, radular teeth and colour patterning. In neither species are the genital organs known. In the Australian species described below, which agrees in every respect with the generic requirements of *Herviella*, a strong penial stylet of the shape of that of the Facalaninae *Godiva* Macnae (1954: 23, fig. 16) arms the tip of the penis.

The New Caledonian *Aeolidia exigua* Risbec (1928: 245-246, pl. 10, fig. 8, text fig. 77), later assigned to *Cratena* (Risbec, 1953: 134) has the cerata in single rows along each side of the body, a few large denticles on the masticatory border of the jaws, three denticles each side of a large cusp in the radular teeth, and its coloration is with black body speckling, black ring at mid-length of the rhinophores and sub-apicial orange band on the cerata. Although the position of the anus is not mentioned, this species is almost certainly a *Herviella*. Its penial armature of an amber spine agrees with the species described below and adds weight to this generic assignment.

H. claror spec. nov. is the first Australian record of the genus.

Herviella claror sp. nov.

Figures 11-15

Material examined: Woody Head, north of Clarence River Heads, northern New South Wales, 153° 22′ East, 29° 20′ South; 2 specimens, 5 October 1959, A.M. reg no. C.63,044 (holotype) and C.63,045 (paratype).

Habitat: Under stone at low tide level.

Description: Alive, the specimens reach 10 mm. in length; preserved the larger (holotype) is 4 mm. long, 1.4 mm. wide and 1.2 mm. high, the cerata are 1.1 mm. long and the sole at its widest is 0.6 mm. The living animals are white, evenly speckled with black pigment on the body, rhinophores and tentacles. Yellow tips surmount the rhinophores and tentacles. Cerata with brownish digestive glands, white cnidosacs, black speckling on the anterior sides only and a narrow orange band below the tip. In alcohol, they are black speckled pinkish with dark brown cream-tipped cerata.

Head broad, rhinophores (Fig. 12, *j*) with bases adjoining, long, slender, straight, and tips rounded; tentacles (*b*) shorter, stouter, curved forward. Foot wider than head, corners rounded, sole (*n*) broad with thin margins, tail pointed. Cerata fusiform, not elongate as in *H. affinis* Baba (1960: fig. 1, A), with small cnidosacs drawn to a point on the top side. Right liver with one oblique row of four cerata; the posterior liver has four oblique rows respectively with 4, 3, 2, 1 cerata.

Genital aperture (*g*) lateral to the right liver row. Anus (Fig. 11-12, *a*) close behind the second row of cerata on the right side, near to the dorsal ceras.

The pale horn jaws (Fig. 13) are 0.7 mm. long and 0.4 mm. high, elongate oval but somewhat narrower at the first third, ventrally in front of which is a protruding bosse as in *H. yatsui* and *H. affinis* (Baba, 1949: fig. 146, A; 1960: fig. 1, C) but narrower and more prominent. The masticatory border is short with two smaller anterior and four large posterior raking pointed denticles. The 13 radular teeth have clear denticles and brown bases. Each (Fig. 14) has a very prominent cusp, longer but not as broad as in *H. affinis* (1960: fig. 1, E) and three diminishing denticles each side.

The genital organs were partially cleared in cedar oil (Fig. 15). The male efferent duct (*e*) is rather long and without swelling; it enters the dilated penial sheath about 1 mm. from the common genital aperture (*g*). The fusiform penis (*h*) projects 0.3 mm. into the 0.6 mm. long pyriform atrium (*f*) where it lies near the anterior wall. A dark brown curved stylet, 0.1 mm. long, tips the penis; it faces rearwards. The common genital aperture (*g*) is broadly oval, its bottom and top edge medianly ridged; these internally thicken as they approach one another and join to form a median division at 0.1 mm. The oviduct (*k*) is broad; the spermatheca (*l*) pyriform, its duct short and wide.

Discussion: *H. claror* approaches its congeners particularly in colour patterning. From *H. yatsui* and *H. affinis,* it is distinguished by the elongate oval jaws and shorter cerata. *H. exigua* (Risbec, 1928: 245), the nearest geographically located species to *H. claror,* has differently shaped radular teeth, and a longer penis with a longer narrower stylet (loc. cit.: fig. 77, i-ii, iv).

In life, *H. claror* is a very bright little species and in allusion to this the specific name is the Latin "claror" signifying "brightness".

REFERENCES

ALDER, J., and A. HANCOCK, 1845-1855. *A monograph of the British nudibranchiate Mollusca.* Pts. 1-7, 438 pp., 84 pls. London (Ray Society).

BABA, K., 1930. Studies on Japanese Nudibranchs, 3. *Venus,* 2(3): 117-125, pl. 4.

———, 1949. *Opisthobranchia of Sagami Bay.* 194 + 7 pp. 50 pls. Tokyo (Iwanami Shoten).

———, 1955. *Ibid.* Suppl. 59 pp. 20 pls. Tokyo (Iwanami Shoten).

———, 1960. The genus *Herviella* and a new species, *H. affinis,* from Japan (Nudibranchia-Eolidacea). *Publ. Seto Mar. Biol. Lab.,* 8(2): 303-305.

———, 1961. Three new species of the genus *Catriona* from Japan (Nudibranchia-Eolidacea). *Ibid.,* 9(2): 367-372, pl. 14-15.

———, 1962. Anatomical review of *Subcuthona pallida* Baba (Nudibranchia-Eolidacea). *Ibid.,* 10(2): 241-243, pl. 15.

BERGH, R., 1896. Eolidiens d'Amboine. *Rev. Suisse Zool.,* 4(2): 385-394, pl. 16.

BURN, R., 1957. On some Opisthobranchia from Victoria. *J. Malac. Soc. Aust.,* 1: 11-29.

———, 1961. Two new species and a new genus of opisthobranch Molluscs from New South Wales. *Proc. Roy. Zool. Soc. N.S.W.,* 1958-59: 131-135.

———, 1962. Descriptions of Victorian nudibranchiate Mollusca. *Mem. Nat. Mus. Melb.,* 25: 95-128.

ELIOT, C., 1910. *A mongraph of the British nudibranchiate Mollusca.* Pt. 8, 198 pp., 8 pls. London (Ray Society).

MACNAE, W., 1954. On some eolidacean nudibranchiate Molluscs from South Africa. *Ann. Natal Mus.*, 13(1): 1-50, pl. 1-2.

MARCUS, E. (and E.), 1955. Opisthobranchia from Brazil. *Bol. Fac. Fil. Univ. S. Paulo, Zool.* no 20: 89-200, pl. 1-30.

———, 1957. On Opisthobranchia from Brazil. *J. Linn. Soc. (Zool.)*, 43: 390-486.

———, 1958. On western Atlantic opisthobranchiate Gastropods. *Amer. Mus. Novit.*, no. 1906: 1-82.

———, 1960a. Opisthobranchia aus dem Roten Meer und von den Maldiven. *Ak. Wiss. Lit. Mainz,* 1959 (12): 871-934.

———, 1960b. Opisthobranchs from American Atlantic warm waters. *Bull. Mar. Sci. Gulf and Caribbean,* 10(2): 129-203.

———, 1961. Opisthobranch mollusks from California. *Veliger,* 3 (Suppl. I): 1-85, pl. 1-10.

ODHNER, N., 1939. Opisthobranchiate Mollusca from the western and northern coasts of Norway. *K. Norske Vidensk. Selsk. Skr.*, 1939 (1): 1-93.

O'DONOGHUE, C., 1929. Report on the Opisthobranchiata. *Trans. Zool. Soc. Lond.*, 22 (6): 713-841.

RISBEC, J., 1928. Contribution à l'étude des nudibranches Néo-Calédoniens. *Faune Colon. Franc.*, 2(1): 1-238, pl. 1-12, A-D.

———, 1953. Mollusques nudibranches de la Nouvelle Calédonie. *Faune Un. Franc.*, 15: 1-189.

WINCKWORTH, R., 1941. The name *Cratena. Proc. Malac. Soc. Lond.*, 24: 146-149.

EXPLANATION OF FIGURES

Fig. 1-6. *Catriona catachroma* sp. nov.

1. Dorsal view of living slug and side view of a ceras.
2. Preserved specimen from right side.
3. Right jaw from inside.
4. Radular tooth.
5. Distal male genital organs.
6. Penial stylet.

Fig. 7-10. *Catriona viridiana* Burn.

7. Lateral view of living slug and a ceras.
8. Right jaw and radula from inside.
9. Radular tooth.
10. Tip of penis and stylet.

Fig. 11-15. *Herviella claror* sp. nov.

11. Dorsal view of living slug and side view of a ceras.
12. Preserved specimen from right side.
13. Right jaw from inside and masticatory border.
14. Radular tooth.
15. Distal portion of genital organs.

R. Burn delin.

Abbreviations: *a*—anus; *b*—tentacles; *c*—cnidosac; *d*—penial gland; *e*—male efferent duct; *f*—male atrium; *g*—genital apertures; *h*—penis; *i*—penial stylet; *j*—rhinophores; *k*—female duct (vagina and oviduct); *l*—spermatheca; *m*—jaws shining through body; *n*—sole of foot.

SOME OBSERVATIONS ON THE EGG CAPSULES AND EMBRYOS OF *TORVAMUREX TERRITUS* (REEVE, 1845)

By FLORENCE V. MURRAY *

With Field Notes by MARGARET H. GOLDSMITH †

Plates 2-4

SUMMARY

T. territus was found spawning on the shells of living *Pinna bicolor* at Shoal Point, Queensland. The eggs are laid in vase-shaped capsules from which the young emerge at the crawling stage. A description of the capsules and embryos is given and some field data included.

Genus *TORVAMUREX* Iredale, 1936, *Rec. Aust. Mus.*, 19: 323.

Murex territus Reeve, 1845, *Conch. Icon.*, 3: *Murex* spec. 167 [Publ. Oct. 1845].

= *Murex turritus* Reeve, 1846, *Proc. Zool. Soc. Lond.*, 1845: 108 [Publ. Feb. 1846] ‡.

Introduction: The life histories of several European species of Muricidae have already been described but the only Australian member of this Family whose life history is known is the oyster drill, *Bedeva hanleyi* (Angas, 1867) which deposits eggs in transparent, lens-shaped capsules (Hedley, 1916). The following account concerns a species whose type locality is quoted as Northern Australia and which produces vase-shaped egg capsules.

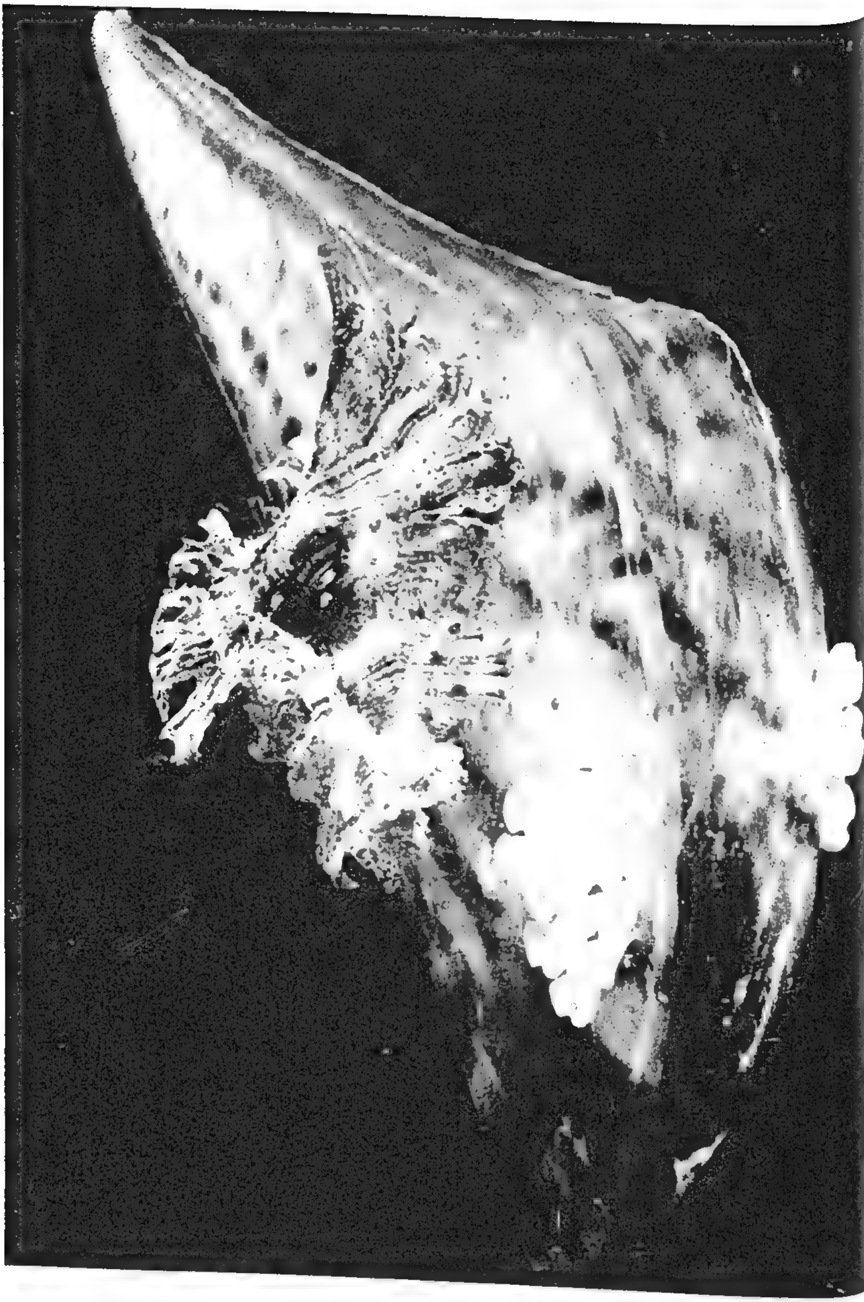
Account: A specimen of *T. territus* (Nat. Mus. Vict., No. F.23555) together with its egg capsules attached to the valves of a *Pinna bicolor* Gmelin (Plate 2) were received from Mrs. Goldsmith on 25 April, 1963; all had been taken alive at Shoal Point, near Mackay, Queensland, packed in seaweed and despatched by air. On arrival, the eggs were in early cleavage indicating that they had been newly spawned when collected two days previously. Four weeks later Mrs. Goldsmith forwarded three groups of similar capsules on *Pinna* shells, each with the contents at a different stage of development—cleaving eggs, early veligers and advanced shelled embryos. Each group was suspended by its shell substratum in a small aerated sea-water tank maintained at 20°C. Every few days some capsules were detached and cut open to release the contents for observation.

The egg stages advanced to very early veligers in three or four weeks, then developed a purple discolouration and deteriorated. The embryos which had reached the early veliger or later stages in the field prior to collection progressed normally into fully-shelled young but ultimately failed to hatch. Overall it appeared that the normal embryonic period would probably be in the vicinity of three months.

Description: The capsules (Plates 2 and 3) (Nat. Mus. Vict., No. F. 23556) are 5 to 7 mm. high, pale amber-coloured, vase-shaped and attached by a basal flange to the substratum in closely-set, irregular rows. Each has a thin, fibrous outer covering which may be stripped off to expose the underlying middle layer or main wall which is thick, rigid and semi-transparent. A loosely attached membrane lines the interior and

‡ The description of *M. turritus* in this publication is a repetition of that given for *M. territus* in *Conchologia Iconica* which was issued first. As we have no means of knowing what Reeve intended, the earlier publication is regarded as containing the original description and therefore *territus*, the prior name, is accepted.

* 13 Gaynor Court, Malvern, Victoria.
† 21 Grendon St., North Mackay, Queensland.



completely surrounds the contents; it is transparent, iridescent and cellophane-like in quality. In transverse section the capsule is approximately oval. On one side the medial portion of the wall is inflected; at first shallow and narrow, this inflection deepens and widens towards the distal end forming a crescent-shaped indentation in the periphery. The roof of the capsule averages about 5 mm. across the widest part and is slightly depressed below the level of the surrounding walls: it has an orifice or exit hole in the centre, and between this and the rim it is raised into a narrow concentric ridge which merges with the rim at the indentation. A thickening of the middle layer forms a broad, sloping border round the exit hole so that the diameter of the opening is greater at the interior of the capsule than at the exterior where it is 1.2 mm. across and flush with the surface. Filling the opening, between the outside fibrous covering and the inner lining, is a thick, hyaline-like plug which loosens and becomes lost in the hatching process. A suture runs across the roof of the capsule and down each side.

A capsule may contain from 9 to 25 eggs suspended in a viscous material; all usually developed, none serving as nurse eggs. Each is spherical, 0.675 mm. in diameter and covered by a fine vitelline membrane. Early cleavage results in quadrant 4D becoming a large passive yolk cell: subsequent divisions of the micromeres and small macromeres give rise to a blastula which is more or less a solid sphere. A ciliated embryo develops within two weeks and transforms into an early veliger stage during the following two weeks. This larva, which precedes torsion, is elongated and consists of an anterior cephalopedal mass of transparent cells and a posterior visceral hump over which the developing shell extends. The embryonic shell is at first colourless and transparent, but after reaching about one whorl in the post-torsional veliger it becomes straw-coloured and then darkens with growth to a rich brown. Within each capsule, however, several remain a golden shade. After approximately two months the shell consists of about one and a half whorls with a well developed canal, a glazed inner lip and a sculpture of spiral, beaded lines. At this stage the animal is colourless with a large bi-lobed velum, two black eyes at the sides of the tentacles near the base and a foot with paired otocysts and an operculum; it is able to retract well within the shell. During the next few weeks shell growth appears to be static while internal organogenesis proceeds at the expense of the yolk reserves: at the same time the foot increases in volume and the velar lobes degenerate. The embryos at this stage could crawl slightly when removed from the capsule, but although the exit holes became unplugged, none emerged and all gradually died. Their shells (Plate 4) (Nat. Mus. Vict., No. F.23557) averaged 1.55 mm. x 1.2 mm. in length and width: comparison with the protoconch on the apex of the adult indicated that they had completed their embryonic development.

Field Notes (By Margaret H. Goldsmith): At Shoal Point, Queensland, on 23rd April, 1963, the tide fell to a very low level exposing a large expanse of reefs, rocks and sand. At the edge of a reef near the low tide limit, in a sandy patch where the rocks were small and sparse and which was uncovered for about an hour and a half, three specimens

---

PLATE 2

Torvamurex territus and its egg capsules attached to the valves of *Pinna bicolor.*

T. territus. Shell: Length 58 mm., width 37 mm., height 38 mm.

P. bicolor. Shell: Length 130 mm., width 53 mm.

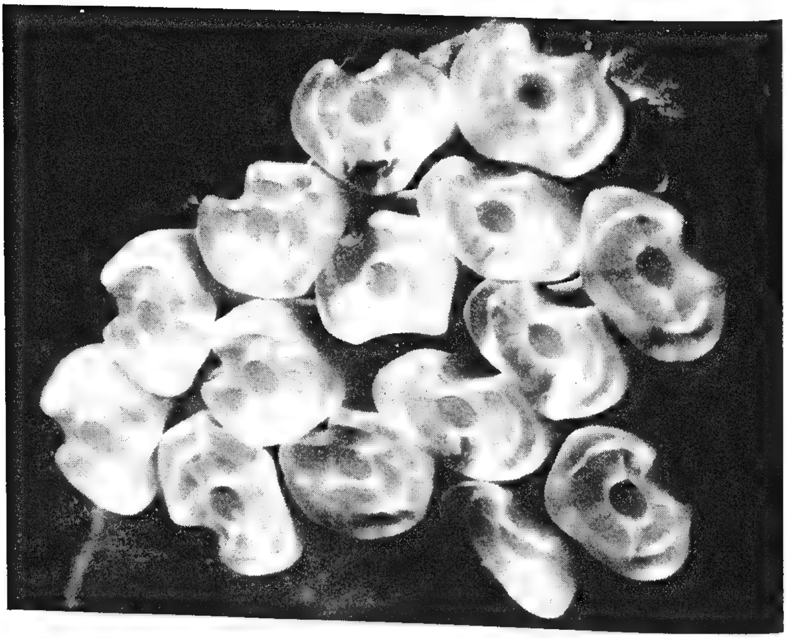


PLATE 3

T. territus: egg capsules, viewed from above. x 4.

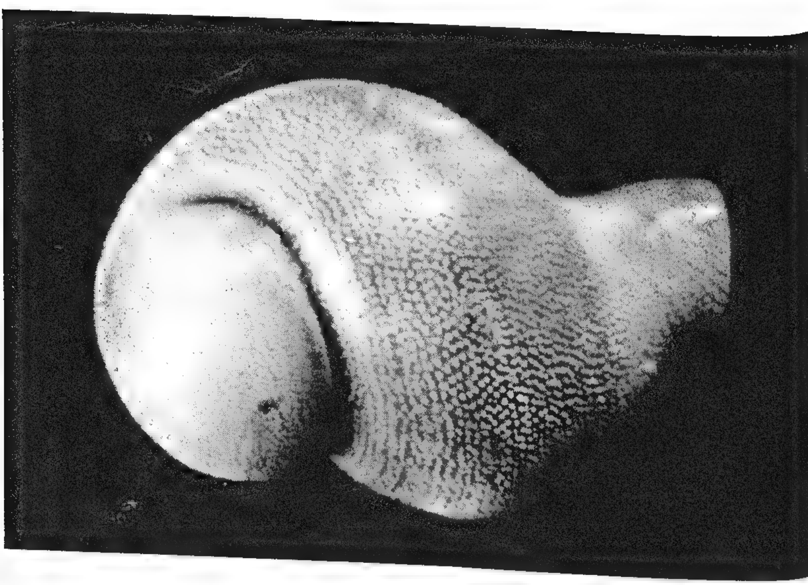


PLATE 4

T. territus: shell of mature embryo. x 55.

of *Torvamurex territus* were found depositing egg capsules on the posterior margins of the valves of live *Pinna bicolor* shells which were in their usual living state—vertically embedded in the sand with only an inch or two of the shell exposed. In each case capsules had been deposited on both right and left valves, but many more on one valve than on the other.

One month later, on 20th May, when the tide was again suitably low, a search of the same area revealed about 20 groups of similar capsules all on *Pinna* shells except two which were on the sides of small rocks. All but one or two of the *Pinna* shells had capsules on both valves; the greatest number noted on any one valve was about 80. Some of the groups appeared darker than the others and contained brown shelled embryos. Only one specimen of *territus* was found depositing eggs on this occasion. The parent shells varied in size, the largest being 58 mm. and the smallest 30 mm. in length.

Over the years I have taken only three or four living specimens of this species in the Shoal Point area, always on sand and not always near rocks. Dead specimens, often in good condition, with hermit crabs are frequently found.

Acknowledgements: The authors wish to express their thanks to Miss J. Hope Macpherson, of the National Museum of Victoria, who identified the specimens and elucidated the nomenclature; to Mr. A. M. of Plates 2 and 3; and to Mr. W. McNutt, of the Microscopy Laboratory, University of Melbourne, for the photomicrograph of Plate 4.
University of Melbourne, for the photomicrograph of Plate 3.

REFERENCES

ANDERSON, D. T., 1960. The life histories of marine prosobranch gastropods. *J. Malac. Soc. Aust.*, 4: 26.

FRETTER, V., and GRAHAM, A., 1962. *British prosobranch molluscs: their functional anatomy and ecology*. (Ray Society, London.)

HEDLEY, C., 1916. Studies on Australian mollusca. Part III. *Proc. Linn. Soc. N.S.W.*, 41: 712.

A NEW DEEP-WATER CHITON (POLYPLACOPHORA: CHITONIDAE) FROM EASTERN AUSTRALIA

By K. L. MILNE *

Text figs. 1-5

COMPONOCHITON gen. nov.

Type Species: *Componochiton raceki* sp. nov.

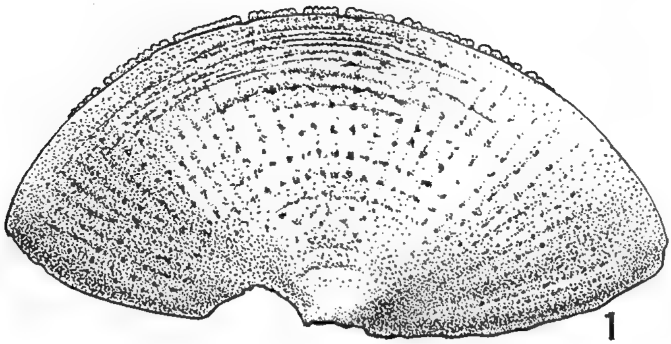
Description: Shell medium sized, elongate oval, very elevated, whole shell pitted in rows, medium valves with lateral areas raised and pitted, posterior valve mucro terminal with postmucronal area comprising only a lip, girdle scales minute closely but irregularly packed, girdle split at posterior extremity; sutural laminae long; slitting, anterior valve 13 (pectinated) median valves 1, becoming degenerate in valves 5, 6 and 7, posterior valve unslit.

Componochiton raceki sp. nov.

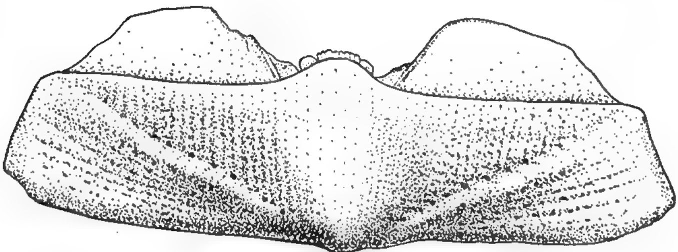
Description: Shell medium sized, preserved holotype approximately 16 mm. long and 11 mm. wide, elongate oval, very elevated, carinate, side slopes straight near jugum then slightly convex, whole shell pitted.

Colour salmon pink, changing to rose pink towards the girdle and insertion areas.

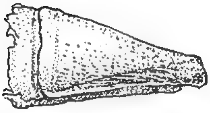
* 14 Burlington Street, Walkerville, Adelaide, South Australia.



1

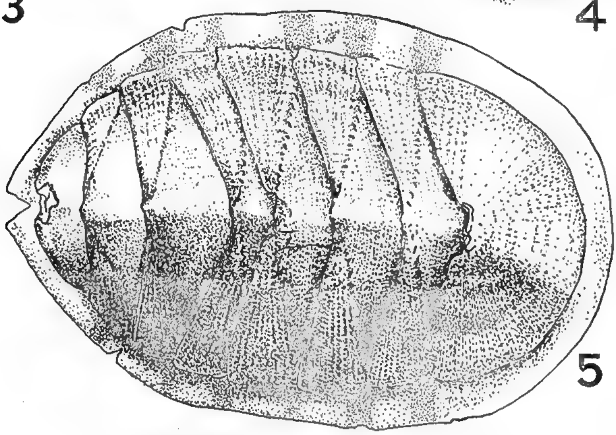


2



3

4



5

EXPLANATION OF FIGURES

Componochiton raceki sp. nov.

Fig. 1. Anterior Valve, Paratype. X 10.
Fig. 2. Median Valve, Paratype. X 10.
Fig. 3. Lateral view of Posterior Valve, Paratype. X 10.
Fig. 4. Girdle scales, Paratype. X 100.
Fig. 5. Whole animal, Holotype. X 5.

Anterior valve obsoletely rayed with numerous very fine ribs (between 65 and 70), apex smooth, otherwise pitted in rows, approximately down ribs and along growth lines.

Median valves with lateral areas raised, also ribbed and pitted similar to anterior valve, with 8-10 obsolete radiating ribs. Central areas almost smooth, with finer pitting than on lateral areas, smooth on dorsal area. There is a row of larger and deeper pits on each diagonal (i.e. the anterior edge of each lateral area) which could be aesthetes (ocelli).

Posterior valve mucro terminal, ante-mucronal area carinated and sculptured as in central areas of median valves; postmucronal area comprises only a lip on each side of the mucro, running from the posterior extremity to edge of valve no. 7, formed of growth lines, but unlike growth lines of other valves.

Girdle wide, with closely but irregularly packed minute scales of nearly uniform size. Colour ochreous with 7 red-brown bands, situated approximately opposite the junctions between the valves. Girdle split at posterior extremity. Underside of girdle made up of silvery asbestoid fibres, extending well beneath insertion plates.

Interior pale pink—paler at sutural laminae, stained with brown under the jugum. Slitting 13-1-0 becoming degenerate in valves 5, 6 and 7. Anterior valve teeth pectinated. Posterior valve not actually slit, but with two flat nodules on each side of the posterior extremity creating grooves which appear at first glance to be slits. Sutural laminae large for size of shell, sinus medium to small, base of sinus pectinated in some median valves.

Types and Type Locality: The holotype in the Australian Museum, Sydney, No. C.63297 (whole shell in alcohol), was taken on "Challenge" trawl 318 from a depth of 160 fathoms, east of Newcastle, New South Wales at night. The paratype specimen (disarticulated) in the National Museum of Victoria, Melbourne, No. F.23568, was taken on another "Challenge" trawl from 75 fathoms off Port Stephens, New South Wales, at day break, on 3rd July, 1959.

Range: In deep water (75-160 fathoms) off central New South Wales.

Remarks: Both specimens were collected by Dr. A. A. Racek, while on board the prawn-survey vessel m.v. "Challenge" in 1959.

The two specimens examined have an unpitted zone about 2 mm. wide on extremities of valves 1-7 which is pinker, smoother and cleaner than the rest of the valve, as if new growth were this colour, the pits developing later and the colour changing or fading to salmon-pink.

The characters described are consistent in the two specimens examined, therefore it is reasonable to assume that the characters are distinctive.

This is evidently a new species which does not conform to any of the genera described by Iredale and Hull (1927) in their "Monograph of the Australian Loricates". Therefore I have proposed for it the new generic name *Componochiton*, which has been chosen to indicate that its characters are a mixture of those of a number of other genera.

The anterior valve resembles that of the genus *Rhyssoplax*, but has many more slits. The median valves have long sutural laminae similar to *Rhyssoplax*, and have a single slit, while the posterior valve resembles in form that of the genus *Poneroplax*. The girdle has the posterior slit seen in *Lorica*, but the scales are very minute and not striate, resembling those of *Stenochiton pilsbryanus*.

REFERENCE

IREDALE, T., and HULL, A. F. B., 1927. *A Monograph of the Australian Loricates.* Royal Zool. Soc. N.S.W., Sydney.

REDESCRIPTION OF *AMORIA DAMPIERIA* WEAVER, 1960 (GASTROPODA: VOLUTIDAE)

By CLIFTON S. WEAVER *

Pls. 5, 6.

A species of *Amoria* widely known under the nomen nudum, *Zebramoria zebra dampieria*, was inadvertently illustrated and briefly discussed by me in the Hawaiian Shell News of October, 1960, under the citation *Amoria* (*Amoria*) *dampieria* (Iredale, 1914) nomen nudum. Although not intended to establish a new specific name, this usage appears to be the first which was accompanied by an illustration and brief description, thus fulfilling the conditions of availability required under the International Code of Zoological Nomenclature. In order to establish the species clearly, it is here redescribed in full.

FAMILY VOLUTIDAE

Genus *AMORIA* Gray

Amoria Gray, 1855, *Proc. Zool. Soc. Lond.* for 1855: 64. Type species (by subsequent designation, Harris, 1897) *Voluta turneri* Griffith and Pidgeon, 1834.

Subgenus *AMORIA* s. str.

Amoria (*Amoria*) *dampieria* Weaver, 1960

(Pl. 5, Pl. 6, centre figs.)

Zebramoria zebra dampieria "Iredale, 1914", Cotton, 1949, *Rec. S. Aust. Mus.*, 9: 191 (nomen nudum).

Zebramoria zebra dampieria "Iredale, 1914", Cotton, 1957, *Aust. Rec. Tert. Spec. Moll. Fam. Volut.* p. 4 (nomen nudum).

Amoria (*Amoria*) *dampieria* Weaver, 1960, *Hawaiian Shell News*, 8 (12): 1,3, figs. 6 and 7.

Remarks: During the Hawaiian-Western Australian Expedition in May and June of 1960, over a dozen living specimens of a lovely little volute were dredged from waters surrounding the Dampier Archipelago at depths ranging from 20-30 fathoms. I tentatively identified them as *Zebramoria zebra dampieria* Iredale, 1914, after a listing I had seen. Further examination of the nucleus showed that they belonged under the subgenus *Amoria* and not the subgenus *Zebramoria*. Their small size, thickened outer lip and longitudinal markings could easily lead the casual observer into mistaking them for *Z. zebra* (Leach), a species of similar appearance living some 2,000 miles away on the east side of the Australian continent.

When I tried to locate the original description and figure of *Z. zebra dampieria*, I found that the name was a nomen nudum. Apparently the name, author and date had been found on a museum label and published without checking on their validity.

The three distinguishing characteristics of this species are its very small size, its smooth papillary nucleus and the extremely thick outer lip of all fully adult specimens. The colour pattern and general appearance of *A. dampieria* resemble those of the much larger *A. ellioti* (Sowerby) but it differs in other characters mentioned above.

* Hawaiian Malacological Society, 2777 Kalakaua Avenue, Honolulu, Hawaii, U.S.A.

Specimens in the Western Australian Museum, Perth, and the Australian Museum, Sydney, show this species to be distributed over some 1,200 miles of coastline from Montebello Id., Western Australia, north-east to Melville Id., Northern Territory.

Description: A very small solid *Amoria* of $2\frac{1}{2}$ adult whorls with a moderately high fawn-coloured protoconch of approximately 3 turns. Body whorl large, aperture rather narrow, interior of aperture coffee coloured, outer lip extremely thick in fully adult specimens. Shell smooth and creamy-white with narrow chestnut longitudinal lines occasionally

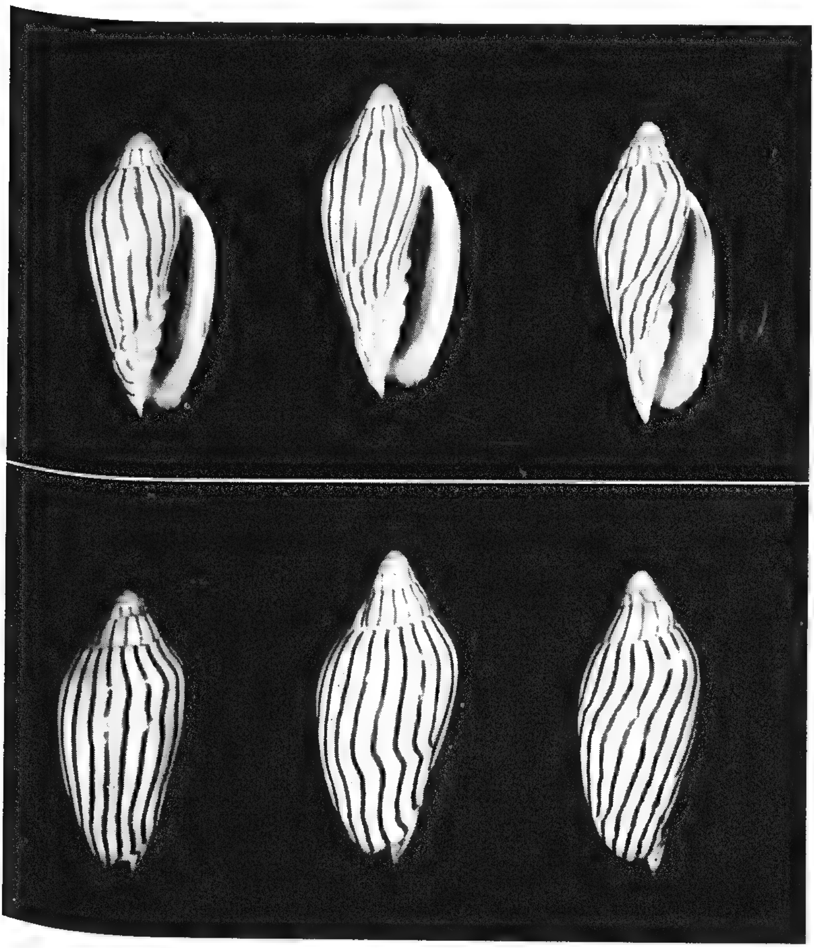


PLATE 5

Amoria dampieria Weaver

All figures natural size.

Two left figures, Holotype. B. P. Bishop Museum No. 205554.
Two centre figures, Paratype No. 1. C. S. Weaver Collection.
Two right figures, Paratype No. 2. B. P. Bishop Museum No. 205557.

TABLE I
MEASUREMENTS (IN MILLIMETERS) AND COLLECTING DATA

Specimens	Maximum			Locality	Collecting Depth in Fathoms	Collector	Collection	Degree of Growth	Remarks
	Length	Diameter	Aperture Length						
Holotype	30.3	14.2	23.5	5 mi. north-west of Steamboat Id., Dampier Arch., Western Australia	28	Hawaiian-Western Australian Expedition	Bernice P. Bishop Museum, Honolulu No. 205554	adult	Freshly dead
Paratype # 1	33.3	15.0	24.1	25 mi. off Bezout Id., Dampier Arch., Western Australia	25	Hawaiian-Western Australian Expedition	C. Weaver	adult	Live collected
Paratype # 2	32.0	13.2	23.0	14 mi. off Delambre Id., Dampier Arch., Western Australia	23	Hawaiian-Western Australian Expedition	Bernice P. Bishop Museum, Honolulu No. 205557	subadult	Live collected
Paratype # 3	26.0	12.1	20.4	Off Delambre Id., Dampier Arch., Western Australia	23	Hawaiian-Western Australian Expedition	Western Australian Museum, Perth No. 16-61	adult	Live collected
Paratype # 4	29.4	14.0	22.5	Off Montebello Id., 80 mi. southwest of Dampier Arch., Western Australia	?	?	Western Australian Museum, Perth No. 5855	adult	Live collected
Paratype # 5	28.0	13.5	21.8	Melville Id., Northern Territory	?	W. Goode	Australian Museum, Sydney No. C. 64020	adult	Subfossil
Paratype # 6	32.0	14.9	23.8	Delambre Id., Dampier Arch., Western Australia	23	Hawaiian-Western Australian Expedition	Australian Museum, Sydney No. C. 64028	adult	Freshly dead
Paratype # 7	28.0	13.0	21.5	Legendre Id., Dampier Arch., Western Australia	32	Hawaiian-Western Australian Expedition	C. Weaver	adult	Live collected

interrupted, these lines about 1½ to 2 mm. apart, running the length of each whorl, but not joining at sutures as in *A. turneri* (Griffith and Pidgeon). There are no other colour markings. The anterior portion of columella bears four small oblique plaits of equal size. A shallow siphonal notch is present.

The following description of the external characters of the living animal is from my diary, written while aboard the m.v. "Davina". "Top of foot chalk-white covered with orange network of fine lines, one such line encircling rim of broadly expanded foot; tentacles chalk-white with one fine orange line running along outer side of each tentacle to form encircling loop near tip. Siphon off-white with two fine orange longitudinal lines on upper portion, these lines encircling siphon at its centre. Base of foot off-white."

Type Locality: 5 miles northwest of Steamboat Id., Dampier Archipelago, Western Australia, dredged in 28 fathoms on June 2, 1960, on a sand and coral-rubble bottom.

Types: The holotype is the shell that was illustrated on the front page (figs. 6 and 7) of the October, 1960, Hawaiian Shell News. This shell, a freshly-dead specimen, is in the Bernice P. Bishop Museum, Honolulu, Hawaii, catalogue No. BBM 205554, as are four paratypes, catalogue numbers BBM 205557, 8, 9. Additional paratypes are indicated in Table I.

REFERENCES

Voluta zebra Leach, 1814, *Zool. Misc.* I, pl. 12, fig. 1.

Voluta turneri Griffith and Pidgeon, 1834, Cuvier's Animal Kingdom, 12, p. 601, Moll. pl. 40, fig. 1.

Voluta ellioti Sowerby, 1864, Thes. Conch., 3, p. 272, pl. 260, figs. 126, 127.

A NEW SPECIES OF *LYRIA* FROM CEYLON (GASTROPODA: VOLUTIDAE)

By CLIFTON S. WEAVER *

Pl. 6.

Recently I received from Mr. Phillip Clover a volute of such striking appearance that I feel it undoubtedly represents a species new to science. Only two crab-occupied shells are known to have been collected. Both were taken by skin-diver Mr. Rodney Jonklaas in 50 feet of water from areas 20 miles apart near Tangalla, southern Ceylon.

FAMILY VOLUTIDAE

Genus *LYRIA* Gray

Lyria Gray, 1847, *Proc. Zool. Soc. Lond.* for 1847: 141. Type species (by original designation) *Voluta nucleus* Lamarck, 1811.

Lyria cloveriana sp. nov.

(Pl. 6, top left hand figure)

Description: Shell rather large (almost 4 inches long), solid, fusiform, high spired; nuclear whorls 2¾, nucleus large, bulbous, very similar to that of *L. lyraeformis* (Swainson); adult whorls 4½, slightly shouldered where longitudinal ribs form low knobs, penultimate whorl with 21 ribs, body whorl with 14 ribs and with large outer lip, somewhat flaring

* Hawaiian Malacological Society, 2777 Kalakaua Avenue, Honolulu, Hawaii, U.S.A.

anteriorly; columellar plaits 19, anterior three plaits strong, the second being strongest, followed by numerous finer plaits the entire length of the columella. Ground colour flesh-pink, with fine orange-red revolving lines about 2 mm. apart covering each whorl and extending as short brown lines to inside of outer lip; orange-red blotches form two broad bands which encircle the body whorl, one at the periphery, another towards the anterior tip; small orange-red blotches occur where longitudinal ribs meet suture; parietal wall with a thin glaze; siphonal notch narrow and deep.

Dimensions: Holotype, maximum length 90 mm., maximum diameter 35.4 mm., aperture length 55.4 mm., greatest diameter of nucleus 3.7 mm. Paratype (juvenile) maximum length 43.6 mm., maximum diameter 17.3 mm., aperture length 26.2 mm., greatest diameter of nucleus 3.1 mm.
Type Locality: Tangalla, southern Ceylon, taken at a depth of 50 feet in rock crevice surrounded by sand, by Mr. Rodney Jonklaas during April, 1963. The paratype, a smaller specimen, was taken by the same collector, 20 miles from Tangalla at the same depth on the same type of bottom.
Types: The holotype has been deposited in the Bernice P. Bishop Museum, Honolulu, under Catalogue No. BBM 205555. The paratype is in the possession of Mr. Jonklaas at the time of writing.
Remarks: The longitudinal ribbing, high spire and bulbous nucleus of this remarkable species resemble those of *Lyria lyraeformis* (Swainson, 1821) while the columellar plaits, swollen body whorl and colour pattern are reminiscent of *Lyria planicostata* Sowerby, 1803. *L. planicostata* may be only a form of *Lyria delessertiana* (Petit, 1842). I am naming the species in honour of Mr. Phillip Clover, who first recognised the possibility that it might be new to science. He very generously donated his only specimen, the holotype, to the Bernice P. Bishop Museum.

The paratype differs from the adult holotype principally in the undeveloped condition of the columellar plaits. In contrast to the 19 plaits found in the holotype, the paratype has only seven (three anterior plaits and four very weak posterior plaits). The body whorl, which is the third post-nuclear whorl, has 16 longitudinal ribs while the penultimate whorl has 17. It should be noted that the nucleus shows a more prominent calcarella than does the holotype.

REFERENCES

LAMARCK, J. B. P., 1811, *Ann. Mus. Hist. Nat. Paris,* 17: 73.
PETIT DE LA SAUSSAYE, S., 1842, *Mag. de Zool.* (2), 4; 1-2, pl. 57.
SOWERBY, G. B., 1903, *J. Malacol.,* 10: 75-76, pl. 5, fig. 7.
SWAINSON, W., 1821, *Zool Illustr.* (1), pl. 54.

DESCRIPTIONS OF TWO NEW SPECIES OF THE GENUS *CYMBIOLACCA* IREDALE (GASTROPODA: VOLUTIDAE)

By DONALD F. McMICHAEL *

Pl. 6; Text figs. 1-8

Some years ago, I gave an account of the genus *Cymbiolacca* Iredale as it was then known (McMichael, 1959). The genus, which may be placed in the sub-family Cymbiinae of the family Volutidae, occurs along the east coast of Australia, ranging from southern New South Wales to north Queensland. I recognised four species, two of which were polytypic, distributed as follows: *Cymbiolacca complexa complexa* Iredale was considered to occur in New South Wales and south Queensland, as far north as the southern side of Fraser Island. *C. complexa nielseni* McMichael was described as a subspecies found in Hervey Bay, to the north of Fraser Island. *C. pulchra pulchra* Sowerby was considered to be the coastal and deepwater species found in the vicinity of the Keppel Islands and Yeppoon, Queensland, and the island groups offshore, while the coral cay dwelling forms from the Capricorn and Bunker Groups were admitted as a polytopic subspecies, *C. pulchra woolacottae* McMichael. *Cymbiolacca perryi* Ostergaard and Summers from Wistari Reef, Capricorn Group was provisionally allotted full specific rank. *Cymbiolacca wisemani* Brazier was recognised as a northern species, occurring on reefs off Cairns and Townsville, north Queensland.

Subsequent intensive collecting along much of the Queensland coast has led to the discovery of a number of new populations which show much variation. One of these has been named *Cymbiola randalli* Stokes, but the others have as yet not been considered in literature. In the present paper these new populations are discussed and two of them are considered to represent new species which are described below.

Genus *CYMBIOLACCA* Iredale, 1929

Cymbiola (*Cymbiolacca*) Iredale, 1929, *Rec. Aust. Mus.*, 17: 181.

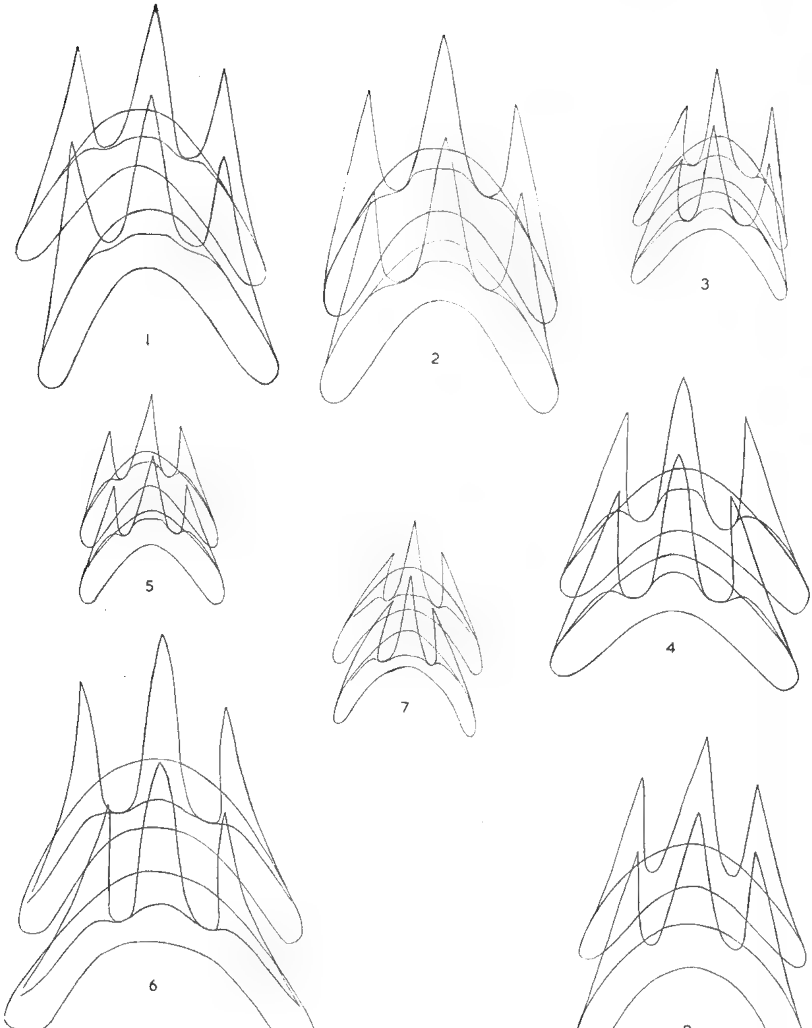
Remarks: I accepted *Cymbiolacca* as a full genus, but Stokes (1961) has suggested that the group does not differ significantly from *Cymbiola*. The generic relationship of *Cymbiola, Aulica* and *Aulicina* requires further consideration, but from all these groups *Cymbiolacca* seems to differ decidedly in the character of its protoconch and in its shell form, both of which are consistent in all known species. The radular teeth of *Cymbiolacca* are quite similar to those of *Aulicina* which is the only one of the three above mentioned groups known so far. I consider that *Cymbiolacca* is a good genus which is clearly separable from related groups, of which *Aulicina* may be regarded as the closest.

Cymbiolacca complexa (Iredale, 1924)

For synonymy, see McMichael, 1959, p. 376.

Remarks: Practically nothing new can be added to the description and range of this species as recorded previously, apart from the radula of the nominate race. Specimens were available from south Queensland, and a radula from one of these, taken off Caloundra, consisted of 85 teeth, very similar in form to those of *C. complexa nielseni* (McMichael, 1959, fig. 1B) and measuring 0.20 mm. maximum width by 0.20 mm. maximum length (text fig. 1); another specimen from off Cape Moreton has a radula with 106 teeth of very large size, 0.21 mm. wide and 0.26

* The Australian Museum, Sydney.



TEXT FIGURES 1-8.

Radular Teeth of *Cymbiolacca* spp.

All teeth are drawn with camera lucida to the same magnification. Actual dimensions are given in the text.

1. *Cymbiolacca complexa complexa* (Iredale). Off Caloundra, Q'ld.
2. *Cymbiolacca complexa nielseni* McMichael. Off Bundaberg, Q'ld.
3. *Cymbiolacca pulchra* (Sowerby). Fitzroy Island, Bunker Group, Q'ld.
4. *Cymbiolacca pulchra* (Sowerby). Swain Reefs, Q'ld.
5. *Cymbiolacca peristicta* n.sp. Swain Reefs, Q'ld.
6. *Cymbiolacca peristicta* n.sp. Swain Reefs, Q'ld.
7. *Cymbiolacca cracenta* n.sp. Off Cape Bowling Green, Q'ld.
8. *Cymbiolacca wisemani* (Brazier). Undine Reef, North of Cairns, Q'ld.

mm. long. Much additional material has been studied, all of which has confirmed the distribution and variation described previously.

The most northerly record for *C. complexa nielseni* is Lady Elliott Island, which lies a few miles north of the mouth of Hervey Bay. It seems that this form is practically confined to Hervey Bay, for shells from near Bustard Head and the Bunker Group coral cays belong to *Cymbiolacca pulchra*. It should be noted that, through a slip of the pen, I spelled the name of the discover of this species Neilsen and named the subspecies *neilseni*, instead of Nielsen and *nielseni*. I consider it correct to alter the spelling under Article 32 of the International Code. An additional radula of this subspecies has been studied; it consists of 67 teeth plus nascents, and the teeth are a little narrower than those of the paratype specimen originally studied. They measure 0.17 mm. broad by 0.20 mm. long and are illustrated in text figure 2.

Cymbiolacca pulchra (Sowerby, 1825)

For synonymy, see McMichael, 1959, p. 378, to which must be added: *Aulicina perryi* Ostergaard and Summers, 1957, *J. Malac. Soc. Aust.*, 1: 30-31.

Remarks: The variation of this species has proved even more complex than previously supposed. A number of new populations have been sampled from coral cays and the deeper waters between the reefs in the Capricorn and Bunker Groups and the Swain Reefs. In nearly every case, each newly discovered population has proved to be subtly different from the others, in some cases recognisable at sight by some particular characteristic of shape, colour and pattern.

Thus Lady Musgrave Island lagoon shells are often pink in hue, with comparatively few, large, dark spots, while Fitzroy Reef shells are slender, light yellow to white in colour. The shell which I referred to this species from Lady Elliott Island (McMichael, 1958, pp. 149-150) has been re-examined and is similar to Lady Musgrave specimens. As Lady Elliott Island specimens collected recently have proved to be *C. complexa nielseni*, I assume that the first mentioned was incorrectly localised. In some parts of the Swain Reefs, the shells resemble those found in deep water in the Capricorn Group and off the Keppel Islands and Yeppoon, but in the vicinity of Hixson Cay, Capre Cay and Gillett Cay (see Gillett and McNeill, 1962, p. 184) in the eastern Swain Reefs, larger shells with prominent shoulder spines and many small spots are found. A population of small shells from deep water off Cape Moreton, Queensland, must be referred to this species, though there is a marked distributional gap between it and the northern populations. It is distinguished by an overall orange-brown coloration, with a short spire and with many small brown spots confined to bands in the normal *pulchra* manner. The shells are all fairly small, not exceeding 50 mm. in maximum length. Among the many shells collected at Lady Musgrave Island are several with an overall pink coloration with large white blotches and very few, if any, dark spots. They thus conform to the characteristics of the shells described as *perryi* from Wistari Reef, Capricorn Group. The latter was previously admitted as a full species, but no further shells of this kind have been found at Wistari Reef despite intensive searching. It is clear from the form of the Lady Musgrave shells that they are simply colour variants of the normal cay population, and similarly *perryi* must now be regarded as merely an uncommon colour variant of the Wistari Reef population. The holotype of *A. perryi* is now in the South Australian Museum, No. D. 14605.

When an attempt is made to apply names to populations varying in this way, the limitations of our trinominal nomenclatural system is revealed. None of these island populations is sufficiently distinctive to

EXPLANATION OF PLATE 6

All figures natural size

Top left: *Lyria cloveriana* n. sp. Holotype, Bernice P. Bishop Museum No. 205555. 50 fm. off Tangalla, southern Ceylon.

Centre top: *Amoria dampieria* Weaver, Holotype, Bernice P. Bishop Museum No. 205554. 28 fm., 5 miles north-west of Steamboat Island, Dampier Archipelago, Western Australia.

Centre bottom: *Amoria dampieria* Weaver, Paratype No. 3, Western Australian Museum No. 16-61. 14 miles off Delambre Island, Dampier Archipelago, Western Australia.

Top right: *Cymbiolacca cracenta* n. sp. Holotype, Australian Museum No. C. 64000. 17-20 fm., 15 miles south-east of Cape Bowling Green, Queensland.

Bottom right: *Cymbiolacca peristicta* n. sp. Holotype, Australian Museum No. C. 64042. 2 fm., Big Sandy Cay, Swain Reefs, Queensland.

Bottom left: *Cymbiolacca wisemani* (Brazier), Australian Museum No. C. 64168. Undine Reef, north of Cairns, Queensland, "*randalli*" form.

Colour block by courtesy Clifton S. Weaver, printing by courtesy K. Gillett.

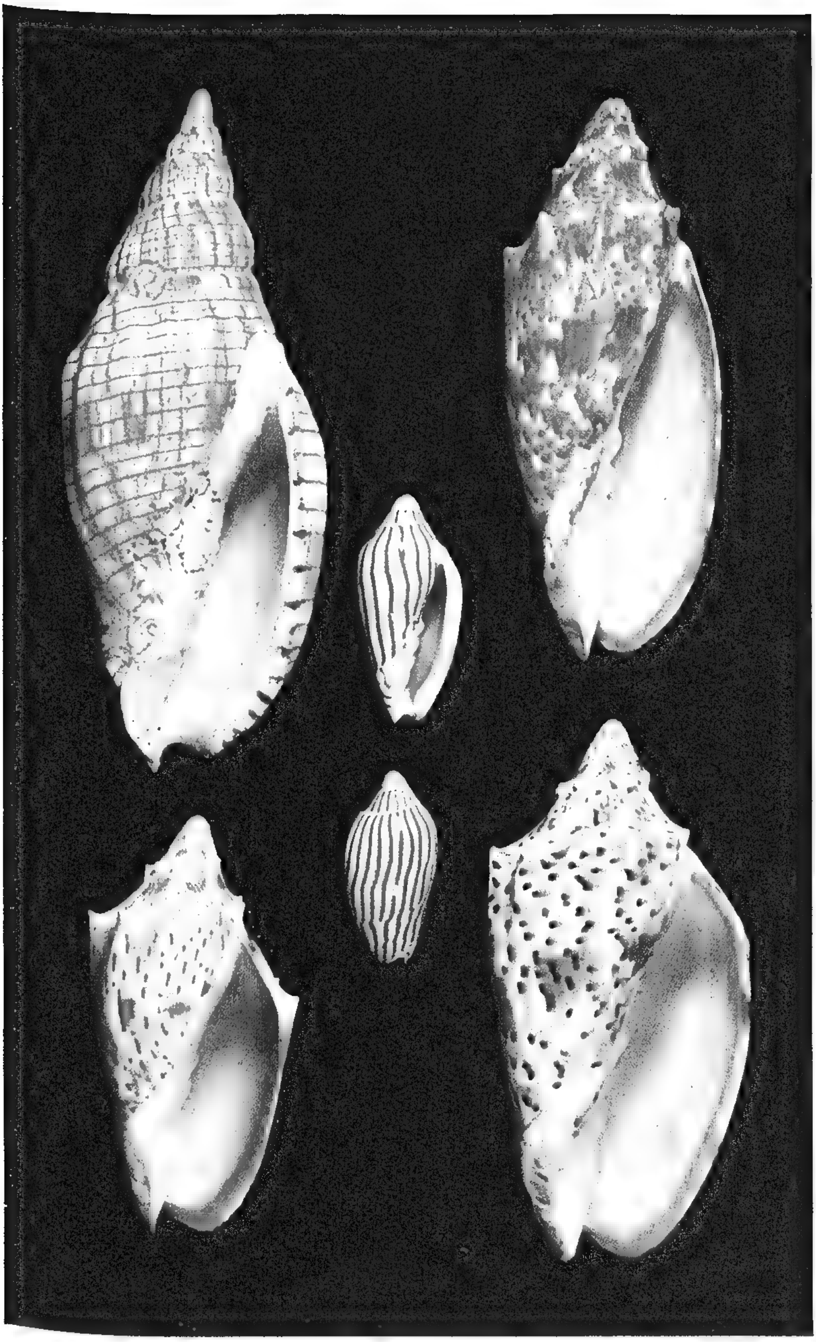


PLATE 6

warrant a sub-specific name and indeed the variation indicates that it is no longer possible to maintain the distinction between the deepwater (and coastal) shells hitherto regarded as *pulchra pulchra* and the coral cay shells which were lumped together under *pulchra woolacottae*. It seems clear that each population is different and is the product of an interaction between its particular genetic constitution (which may be quite distinctive as a result of a high degree of inbreeding) and the local environment in which it is found.

Since writing on this species previously, I have examined the holotype of *Voluta pulchra* Sowerby in the British Museum. On comparing it with the many populations now known for this species, I now consider that it is not, after all, identical with any of the coastal shells studied to date. In fact the shell does not match any of the coastal, deepwater or coral cay populations closely, though it is clearly one of the "pulchra" series and not any other species of *Cymbiolacca*. When considering its identity at first, I concluded that it had been collected by Cook's party and must therefore have been collected at either Bustard Bay or Thirsty Sound, the only two localities within the range of the species which Cook visited. Reconsideration of this has not solved the problem. The shell was described in 1825 and must have been collected at some time prior to that date. The only navigators who visited this part of the Queensland coast before 1825 were Cook, Flinders and King. A study of the voyages of all three shows that none of them visited any of the Bunker or Capricorn Groups from which the shell might have been collected. Flinders anchored in Bustard Bay and near Gatcombe Head; he then spent some time in the vicinity of Port Curtis (where dredging was done) and Keppel Bay and a party visited Hummocky Island, and shells were undoubtedly collected. Iredale (1939, P. 211) claimed that only Cook's shells could have reached England prior to 1820, but Flinders may have brought back some shells. After his ship was wrecked in 1803 on Wreck Reef, he stated that "the naturalist . . . who remained at Port Jackson had put on board only a small part of their collection of specimens," and also that "My little collection in mineralogy and conchology was much defaced, and one-half lost". Presumably the remainder accompanied him to Mauritius, where he was imprisoned from 1803 to 1810. On his release, he made a list of those items which had been seized by the French, but which were not returned to him. These included a cask of rock specimens, but no mention was made of any shells, so that these may have reached England safely in 1810. King collected at Rodd Bay, near Bustard Head, but his collections were described by Gray in an Appendix to King's narrative and King (1826, p.410) stated that "every species brought home" by his Expedition was included in the report, and *Voluta pulchra* was not among them. This leaves only Cook and Flinders as possible sources of the specimen, and in each case, the localities at which collections were made are ones which do not seem to agree with the type specimen.

For the time being, the actual identity of the population from which the type of this species was collected must remain a mystery. Despite this, the specific name seems well established and with the relegation to synonymy of the subspecies name *woolacottae* and the species *perryi*, the way is open for a more realistic description of the variation of the species, using vernacular or geographic descriptive terms. The radula from numerous specimens has been studied and has been found to vary widely, ranging from a small specimen from Fitzroy Island (fig. 3) with 79 teeth measuring 0.12 mm. wide by 0.11 mm. long, to a large specimen from Lady Musgrave Island with 110 teeth measuring 0.29 mm. square while an average sized specimen from the Swain Reefs has 94 teeth plus 10 nascents, measuring 0.18 mm. wide by 0.19 mm. long (fig. 4).

Cymbiolacca peristicta sp. nov.

(Pl. 6, bottom right hand figure)

Description: Shell medium sized, of 6½ whorls, the maximum length about 75 mm.; body whorl broad, shouldered and bearing sharp, outstanding spines which become reduced and cease about 20 mm. behind the outer lip. Colour pinkish white, with numerous very dark brown or black spots of varying size, scattered over the shell, but predominantly beneath the shoulder, black spots with pale pink to brown triangular patches adjacent to them; aperture pink, bordered inside the lip with pale orange. Columellar plaits four, of moderate strength.

Animal with small head and tentacles, prominent eyespots, and rather broad lateral lobes to the head; siphon long, bearing prominent, long appendages of equal size; males with a large club-shaped penis, flattened along its inner surface, originating just posterior to the right lateral lobe.

Radula consisting of 85 teeth plus several nascents, size variable, in one specimen 0.10 mm. broad by 0.11 mm. long (fig. 5) in another 0.23 mm. broad by 0.19 mm. long (fig. 6).

Types and Type Locality: The holotype and one paratype are in the Australian Museum, Sydney, Registered Numbers C. 64042 and C. 64043 respectively. Additional Paratypes are in the National Museum of Victoria (F. 22757), the U.S. National Museum (No. 631775), The Museum of Comparative Zoology, Cambridge, Mass. (No. 208801), and The British Museum (Nat. Hist.).

All known specimens come from one locality, and the majority were from one reef collected by Mr. T. Nielsen, of Yeppoon, Queensland. Mr. Nielsen informs me that the locality is known to fishermen as Big Sandy Cay and is situated at 151° 57′ E. Longitude by 21° 48′ S. Latitude in the western part of the Swain Reefs. All were dredged in about 2 fathoms.

Remarks: The brief description given is sufficient to diagnose the species which otherwise possesses all the features of the genus. It is well characterised by the bold spotting of the shell, which is more prominent than in any other species. The shell was first illustrated on the cover of "Shells of the Seashore" (D. F. McMichael, 1958, Jacaranda Press, Brisbane, Queensland). The relationship of this species is obscure. It seems to be isolated in a small area of the Swain Reefs, with *Cymbiolacca pulchra* its nearest (geographically) relative to the South and East. It differs from that species in possessing black spots all over the shell, and from *Cymbiolacca complexa, C. cracenta* and *C. wisemani* in the strength and character of the black spots. In these species the spots are smaller and the ground colour is in each case different from the present species.

Cymbiolacca cracenta sp. nov.

(Pl. 6, top right hand figure)

Description: Shells small to medium sized, maximum length about 70 mm., slender, the maximum width about 30 mm., protoconch of 3½ whorls, orange-pink, with prominent white ribs; adult whorls 3, the body whorl large, spire short; whorls not notably shouldered, but bearing short, sharp, appressed spines; colour brownish red, with a lighter pink ground colour, and broad bands of irregular blotches of deeper reddish brown, generally sprinkled with very fine black spots; aperture white, bordered with orange brown.

Radula consisting of 84 very small teeth, measuring 0.12 mm. square (text figure 7).

Types and Type Locality: Dredged in 17-20 fathoms, 15 miles South-East of Cape Bowling Green (south of Townsville), Queensland. The holotype

and two paratypes are in the Australian Museum, Sydney, Registered Numbers C. 64044, C. 64045 and 64063 respectively. Additional paratypes are in the U.S. National Museum (Nos. 631774 and 613532), the Museum of Comparative Zoology (No. 208804), the British Museum (Nat. Hist.) and the National Museum of Victoria (F. 23822).

All known specimens have been dredged in a limited area around Townsville and Cape Bowling Green, Queensland. One paratype (USNM 613532) is localised as 25 fm. off Bowen, Queensland. According to Mr. T. Nielsen, this would be the southern limit of the range.

Remarks: The first specimens of this species collected in recent years were obtained by the prawn survey vessel, M.V. "Challenge", while many others have been dredged by Mr. T. Nielsen. The "Challenge" collected a specimen of this species, supposedly in Princess Charlotte Bay, north Queensland (which I previously recorded as *C. complexa nielseni,* indicating that the locality was doubtful), but until further specimens are located in that area, it must be regarded as simply mislocalised. All were at first thought to be specimens of *Cymbiolacca complexa,* but comparison shows that the present species is much more slender, the colour pattern is more red with the banding prominent and there is a distinct geographical break, the northermost *complexa* being found in Hervey Bay, while the present species is not found south of Bowen, a gap of more than 300 miles.

Cymbiolacca wisemani (Brazier, 1870)
(Pl. 6, bottom left hand figure)

For synonymy, see McMichael, 1959, p. 380, to which must be added: *Cymbiola randalli,* Stokes, 1961, *Roy. Soc. S.A. Malac. Sect. Publ.,* 16: 3,4.

Remarks: The variation of *Cymbiolacca wisemani* (Brazier) was considered to be polytopic, with some populations having notably spotted shells, geographically interspersed with the faintly spotted and unspotted populations which had come to be regarded as typical. I pointed out that the holotype bore minute dark spots, as did specimens from Keeper Reef, near Townsville, and Undine and Mackay Reefs, near Cairns. During the ensuring years numerous specimens were collected at Undine Reef and St. Crispin's Reef, some miles north of Cairns in which the spots were prominently developed as thin, elongate vertical dashes. This form was subsequently named *Cymbiola randalli* Stokes, but it cannot be maintained as a distinct species, because there is continuous variation between it and the unspotted shells. Nor can it be maintained as a subspecies, because it is no more geographically isolated than other slightly divergent coral cay populations. The holotype, originally in the collection of its collector, Mr. A. J. Randall, has been presented to the National Museum of Victoria, Catalogue No. F. 22758. It measures 64.5 mm. maximum length by 31 mm. maximum diameter. The radular teeth measure 0.20 mm. square (fig. 8), but as only a fragment of the radula was obtained from a specimen from Undine Reef, the number of teeth could not be determined.

REFERENCES

GILLETT, K., & F. A. McNEILL, 1962, *The Great Barrier Reef and Adjacent Isles.* 2nd Ed., Coral Press, Sydney.

IREDALE, T., 1939. Mollusca, Part 1. *Gt. Barrier Reef Exp. 1928-29, Sci. Repts.* 5: 209-425.

KING, P. P., 1825. *Narrative .... Survey .... Intertropical and Western Coast .... Australia.* Vol. 2, John Murray, London.

McMICHAEL, D. F., 1959. Marine Mollusca of Eastern Australia 1. The Genus *Cymbiolacca* Iredale (Family Volutidae). *Aust. Zool.,* 12: 374-383, pl. 44.

STOKES, A., 1961. A new species of Volute, from Undine Reef, Queensland, *Cymbiola randalli* sp. nov. *Roy. Soc. S.A. Malac. Sect. Publ.,* 16: 3-4, text figs.

NEW SPECIES OF MOLLUSCA FROM EASTERN AUSTRALIA

By T. A. GARRARD *

Pl. 7, figs. 1-10

The continual discovery of new species of molluscs on the eastern coast of Australia, mainly by dredging and trawling in deep water, is rather astonishing, especially when coupled with the finding of many named species not previously recorded from Australia. I refer mainly to large shell-bearing molluscs, apart from recent discoveries amongst the Nudibranchia and other molluscan fauna, and doubtless many smaller species will come to hand during the next few years.

Although a number of well known species, including many formerly thought to be indigenous to Japan, have been found living off the coast of Queensland during the past two or three years, unfortunately only a few have come into the possession of the Australian Museum, and it is therefore not considered desirable to list the names at this time. However, several new species which I have acquired during this period are described below, and the types in each case have been presented to the Australian Museum.

CLASS PELECYPODA (LAMELLIBRANCHIA)
SUBCLASS TELEODESMACEA
FAMILY CARDIIDAE

REGOZARA Iredale 1936, *Rec. Aust. Mus.*, 19: 275. Type species by original designation *olivifer* Iredale.

Regozara fraseri sp. nov.

(Pl. 7, fig. 1)

Remarks: This species, apart from the heavy periostracum, bears a superficial resemblance to the well known *Regozara racketti* Donovan, but the sculpture is quite distinctive. The specimens were obtained from the former well known prawning ground east of Tin Can Bay several years ago, and specimens from other localities have so far not come under notice.

Description: Shell equivalve, inequilateral, swollen, produced posteriorly and slightly truncated, anterior end rounded and slightly produced near lunule; exterior ligament; sculpture of about 37 sharp radiating ridges extending from umbos to ventral margin, each covered with sharp vertical prickles, with a well defined square sided channel in each interstice; flat topped ribs well defined in interior; muscle scars small and close to margins, pallial line and sinus indiscernible. Colour off-white tinged with red-brown at posterior end, interior white. Periostracum dark brown and heavy.

Dimensions: Holotype, length 37 mm., height 36 mm., section of conjoined valves 29 mm.

Type locality: Trawled in 35 fathoms east of Tin Can Bay, south east of Fraser Island, Queensland.

Types: Holotype presented to Australian Museum, Sydney, where it is registered No. C. 64068 with one paratype; three paratypes in author's collection.

* 3 The Circle, Dundas, N.S.W.

FAMILY DOSINIIDAE

PARDOSINIA Iredale 1929, *Mem. Qd. Mus.,* 9: 264. Type species by original designation *colorata* Iredale.

Pardosinia extranea Iredale 1937.

(Pl. 7, figs. 2, 3)

Pardosinia alma extranea Iredale, 1937, *Aust. Zool.,* 8: 241.
Remarks: In naming a single valve of this sub-species of *Pardosinia alma* Iredale from Michaelmas Cay, Q., it was stated that the variation seen, narrower and with finer sculpture, was not fully understood, and Iredale adopted his usual practice of naming it as a sub-species pending further material coming to hand. A large series of live specimens dredged in the lagoon at Lady Musgrave Island confirms the differences between *Pardosinia alma* and *P. extranea,* and it is considered that *extranea* should now be elevated to full specific rank. Two specimens are figured to show the great variation which can occur in the pattern, always red-brown on a white ground.

CLASS GASTROPODA
SUBCLASS PROSOBRANCHIA
FAMILY CYMATIIDAE

LINATELLA Gray 1857. *Guide Syst. Dist. Moll. Brit. Mus.* p. 39. Type species by monotypy *Linatella cingulata* Lamarck.

Linatella neptunia sp. nov.

(Pl. 7, figs. 7, 8)

Remarks: This species first came to notice about four years ago and is apparently still a rare shell, only four having been noted in addition to the holotype. It is closely related to *Linatella cingulata* Lamarck, which differs in having flat topped ribs and interstitial spiral threads between the ribs, as opposed to the well rounded ribs and lack of threads on this new species. Unfortunately only one specimen of *Linatella cingulata* has been available to me for comparison, and contrary to the original description stating that it possesses a straight anterior canal, the canal in this specimen is well recurved, similar to the five specimens seen of this new species.

Description: Shell of five main whorls, apex missing, whorls shouldered, spire fairly elevated, sutures a little impressed, mouth wide and open, anterior canal short and wide, columella straight, inner lip greatly reflected at anterior end and with heavy callus at posterior end; umbilical chink present; sculpture of sixteen heavy encircling cords on body whorl, five or six on other whorls, one heavier and somewhat nodular whorl forming the well defined shoulder, the whole crossed by irregular growth lines; outer lip a little thickened and reflected; interior fluting corresponding to exterior cords is carried well into mouth of shell; colour off-white.

A specimen in the collection of Mrs. M. Bowman of Yeppoon, Q., carries a strong lamellate varix on body whorl in line with inner lip, not present in other specimens.

Dimensions: Holotype, length 60 mm., breadth 34 mm., aperture 42 mm.
Type locality: Trawled in 30 fathoms off Southport, Q.

Types: Holotype presented to the Australian Museum, Sydney, by courtesy of Mr. P. McI. Forrest of Toowong, Brisbane. Registered No. C. 62522. One paratype in author's collection from 30 fathoms off Tweed Heads, N.S.W., and two from 35 fathoms off Tin Can Bay, south east of Fraser Is., Q.

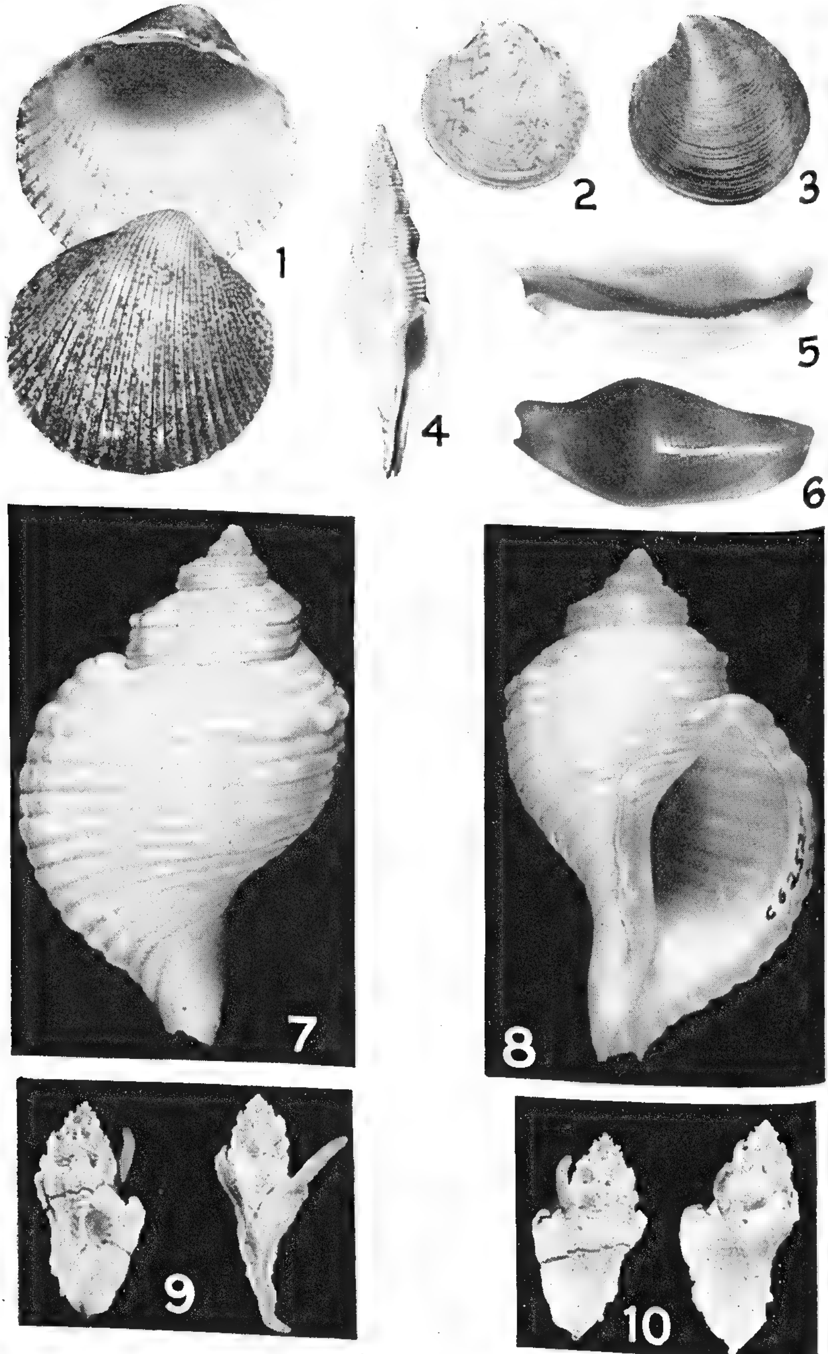


PLATE 7

SUPERFAMILY CYPRAEACEA
FAMILY OVULIDAE
SUB-FAMILY VOLVINAE

NEOSIMNIA Fischer 1884, *Man. de Conch.*, p. 664. Type species by original designation *spelta* Linné 1758.

Neosimnia tinctura sp. nov.

(Pl. 7, figs. 5, 6)

Remarks: This beautiful little species joins *N. formicaria* Sowerby and *N. subreflexa* Adams and Reeve as a third species of this interesting genus to be found on the eastern Australian coast. All appear to live on the narrow branches of gorgoniae and small types of coral, and this new species is no exception, being found on gorgoniae in Moreton Bay, Q. However, the species appears to be fairly widespread as the author has also found worn specimens on beaches at Yeppoon and near Burnett Heads, Q.

Description: Shell elongated and roughly cylindrical in shape, with carinated angle above the centre, extremities blunt, outer lip thickened and calloused; aperture widens anteriorly; fossula smooth and prominent, forming a distinct keel on columella; fairly strong labial teeth at posterior end, becoming weaker and disappearing entirely at anterior end; dorsal surface entirely covered with fine wavy striations; general coloration fawn, with narrow whitish band encircling the carination; further indistinct whitish bands towards either end, the extremities themselves tipped with bright reddish-orange, outer lip bright yellow, fossula bright pink.

The bright reddish-orange extremities are a distinguishing feature of this shell, persisting even in well worn specimens.

Dimensions: Holotype, length 9 mm., width 4 mm.

Type locality: Living on the alcyonarian *Mopsella* in 7-8 fathoms, Moreton Bay, Q.

Types: Holotype presented to Australian Museum, Sydney, where it is registered No. C. 64070, together with several paratypes, and several others in author's collection.

FAMILY FASCIOLARIIDAE

LATIRUS Montfort 1810, *Conch. Syst.*, 2: 530-531. Type species by original designation *gibbulus* Gmelin.

Latirus thesaurus sp. nov.

(Pl. 7, fig. 4)

Remarks: This fine species adds a second to the genus for the State of New South Wales, the only other recorded being *L. turritus* Gmelin, and is a somewhat surprising find for the locality, which has been trawled for so many years in the depth at which the specimen was found.

Fig. 1. *Regozara fraseri* sp. nov. Holotype. Aust. Mus. No. C. 64068.

Figs. 2, 3. *Pardosinia extranea* Iredale. Lady Musgrave Island. Aust. Mus. No. C. 64069.

Fig. 4. *Latirus thesaurus* sp. nov. Holotype. Aust. Mus. No. C. 64071.

Figs. 5, 6. *Neosimnia tinctura* sp. nov. Holotype. Aust. Mus. No. C. 64070.

Figs. 7, 8. *Linatella neptunia* sp. nov. Holotype. Aust. Mus. No. C. 62522.

Fig. 9. *Typhisopsis occlusum* sp. nov. Holotype (left) and Paratype (right).

Fig. 10. *Typhisopsis occlusum* sp. nov. Holotype (left, Aust. Mus. No. C. 64072) and Paratype (right, T. A. Garrard Collection).

Description: Shell fairly narrow and fusiform, of eight main whorls with simple smooth protoconch of one whorl, merging gradually into sculpture of main whorls, which are somewhat convex, sutures impressed; sculpture consists of strong axial plications, ten on penultimate whorl, diminishing in number towards the spire, and tending to disappear on body whorl; nine or ten raised spiral lirae on each whorl over-ridden by growth lines which become pronounced on body whorl; aperture narrow and half total length of shell, lip slightly reflected and showing slight indentations due to raised external lirae; anterior canal open, straight and narrow; colour uniform light brown, spiral lirae whitish, anterior end stained dark purple brown, interior of aperture pinkish brown.
Dimensions: Holotype, length 42 mm., breadth 12 mm., aperture 21 mm.
Type locality: Trawled in 40 fathoms east of Port Hacking, New South Wales.

Types: Holotype, the only known specimen, presented to the Australian Museum, Sydney, where it is registered No. C. 64071.

FAMILY TYPHIDAE

TYPHISOPSIS Jousseaume 1880, *Le Naturaliste*, year 2, pp. 335-6. Type species by original designation *coronatus* Broderip.

Typhisopsis occlusum sp. nov.

(Pl. 7, figs. 9, 10)

Remarks: Several specimens of this new species, rather old and beach worn, were first obtained by Mr. Tom Iredale some years ago on Lindeman Is., Q., but owing to their worn state it was decided to await better material. Two live specimens dredged in 17 fathoms off Hayman Is., in Whitsunday Passage, by Mr. Tom Nielsen, are fortunately in perfect condition, and are a fascinating addition to the Family on our coast.
Description: Shell is a typical *Typhis* as regards formation of the spire, with one open foramen between each varix. Whorls number six, flat topped, varices raised vertically in form of a hollow spine, each foramen joined to varix of preceding whorl, last foramen produced to half an inch in length, curving away from body whorl directly behind mouth of shell; protoconch of 1½ whorls, smooth, set at an oblique angle, merging gradually into main whorls; lip thin, greatly expanded and recurved; anterior canal completely closed except at extreme end and curved sharply back; mouth very small, produced and recurved all round; apart from peculiar flange-like varices and foramina, surface sculpture consists of irregular growth striae only; colour white shading to light creamy brown, dark spiral lines show through a white glaze over whole shell, a few brown marks on outer lip, one chocolate line encircles centre of each whorl in holotype, absent from paratype; operculum horny, light brown, broadly pear shaped, with strong ridges extending in waves from a terminal nucleus.

Dimensions: Holotype, length 27 mm., width 14 mm., aperture 4.5 mm. Paratype 31 x 16 mm.

Type locality: Dredged in 17 fathoms off Hayman Island in Whitsunday Passage, Q.

Types: Holotype presented to Australian Museum, Sydney, where it is registered No. C. 64072; one paratype in author's collection.

ANATOMICAL NOTES ON *CYPRAEA AURANTIUM* GMELIN AND OTHER COWRIES AND AN EXAMINATION OF THE SUBGENUS *LYNCINA* TROSCHEL

By E. ALISON KAY *

Pl. 8, figs. 1-9, Text figs. 1-12.

INTRODUCTION

In June, 1962, I received a single preserved specimen of the golden cowry, *Cypraea aurantium* Gmelin, from Mr. F. Lahore of the Philippine Islands. The lack of anatomical knowledge of this species is in itself reason for a note on its anatomy, particularly since there are differences of opinion concerning the relationships of *C. aurantium*. In the course of the study it became apparent that *C. aurantium* resembles eight Indo-Pacific species in radular pattern, mantle characters, and genitalia. A survey of the literature disclosed that all nine species have been at one time or another associated with the cypraeid subgenus *Lyncina* of Troschel (1863). The purpose of the present paper has, therefore, become two-fold: to present anatomical descriptions of *C. aurantium* and species pertinent to a consideration of its relationships, and to re-examine Troschel's cypraeid subgenus *Lyncina*.

Lyncina Troschel 1863 lies within the maze of taxonomic superstructure which has arisen around the gastropods commonly known as the cowries (Cypraeinae, *sensu* Thiele, 1931; *Cypraea, sensu* Kay, 1960). Troschel, recognizing four genera of cowries, limited his concept of the genus *Cypraea* to those glossy-shelled species in which there is a spoon-shaped depression in the fossula. He further subdivided the genus into four subgenera on the basis of a combination of conchological and radular characters. The subgenus *Lyncina* originally included six species (*C. carneola, C. lynx, C. vitellus, C. camelopardalis, C. mappa,* and *C. argus*) which Troschel anatomically characterized as having the median radular tooth anteriorly distinctly rounded—"Mittelplatte vorn spitz abgerundet, die Seitenzahne der Schneide ebenso gross wie der mittlere Hauptzahn." (Troschel, 1863).

Lyncina Troschel has since been incorporated as a subgenus in the concepts of the genus *Cypraea* elaborated by Thiele (1931), Schilder (1939), and Schilder and Schilder (1938-1939), and has been raised to generic rank by Iredale (1935). Thiele (1931) modified Troschel's subgenus by removing *C. mappa* to a separate subgenus within his concept of *Cypraea*, but added both *C. aurantium* and *C. reevei*. The Schilders (1938-1939), while adding two species (*C. leviathan* and *C. ventriculus*), also excluded *C. mappa* and, in addition, removed *C. argus* and *C. aurantium*, placing the former in *Talparia* where it is grouped with *C. talpa* and *C. exusta*, and the latter in *Callistocypraea* with *C. testudinaria, C. nivosa, C. broderipi* and *C. leucodon*. Iredale (1935), followed by Steadman and Cotton (1946) and Allan (1956), raised *Lyncina* to generic rank, recognizing only one species, *C. lynx*, and distributed the other species which Troschel, Thiele, and the Schilders had associated with *Lyncina* among various genera.

* General Science Department, University of Hawaii, Honolulu, Hawaii, U.S.A.
Contribution No. 194, Hawaii Marine Laboratory.

MATERIAL AND METHODS

Of the ten species which have been associated with *Lyncina,* eight will be described below; preserved specimens of *C. camelopardalis* and *C. ventriculus* were not available for the study. In addition, the anatomy of *C. testudinaria* and *C. talpa* will be described because of their association by the Schilders (1938-39) with *C. argus* and *C. aurantium.*

The mantle, radula, and genitalia have all been studied in animals preserved in 70% alcohol or 10% formalin without previous relaxation. Although there are various anatomical descriptions from several of the species, these are somewhat scattered in the literature, and new descriptions seem justified. I have not been able to detect differences in the ctenidia and osphradia, except in the case of *C. testudinaria,* and neither these structures nor the nervous system are included in the anatomical descriptions. Descriptive terminology for the mantle, papillae, and siphon is that of Schilder (1936). Where descriptions of living animals were available, these are included.

Radulae were prepared by mounting them unstained in Euparal. Although the oxidation-dahlia staining technique of Bowell has previously been utilized (Kay, 1960), I have found that unstained mounts in Euparal produce satisfactory results. Only fully formed teeth were included in the counts of radular rows; determination of the beginning of the nascent teeth was made by micrometer measurement and those teeth one-half the size of the majority in the radular ribbon were considered nascent.

Radular terminology is primarily that of Schilder (1936): the rachidan or central tooth is termed the median, the teeth bordering it the admedians, and the teeth flanking the latter the inner and outer marginals. The teeth are anteriorly tri-cuspid and the cusps will be referred to as central and lateral. I will refer to the posterior projections of the corners of the tooth as basal cusps, while those associated with an internal bract will be termed basal denticles. The internal bracts are dense portions of the tooth which form distinctive horizontal or vertical patterns within the body of the tooth.

Terminology referring to the genitalia is that of Kay (1960). The bursa copulatrix which is present in the females of a number of cowries is a typically pyriform structure at the terminus of the reproductive ducts.

ACKNOWLEDGMENTS

I am indebted to numerous people who have provided specimens of prized cowries for my studies. The specimen of *C. aurantium* was obtained through the perserverence of Mr. Karl Greene of Honolulu, Hawaii, who has for many years devoted himself to the pursuit of the golden cowry. The specimen of *C. mappa* was received from Mr. John Roberts of the Marshall Islands; that of *C. argus* from Mr. F. Dayrit of the Philippine Islands; and that of *C. testudinaria* from Dr. J. Knudsen of the Zoological Museum, Copenhagen. Many specimens of other species have been made available by Dr. C. M. Burgess of Honolulu, Hawaii. Living specimens of *C. lynx, C. vitellus,* and *C. carneola* were provided by Mr. Herbert Ward, formerly of Agana, Guam, and Mrs. James Andrus and Mrs. Arch Harrison of Honolulu, Hawaii.

DESCRIPTIVE ANATOMY

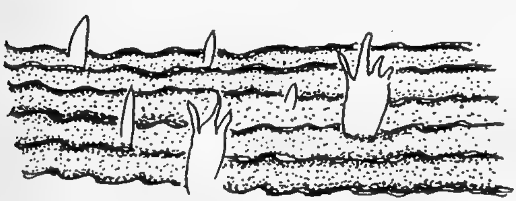
Cypraea argus Linnaeus

Fig. 1; Fig. 6a; Pl. 8, Fig. 7

Material examined. 1 specimen: length, 66 mm.; width, 35 mm.; height, 27 mm.; from a reef at Laminusa Siasi, Sulu, June, 1960.

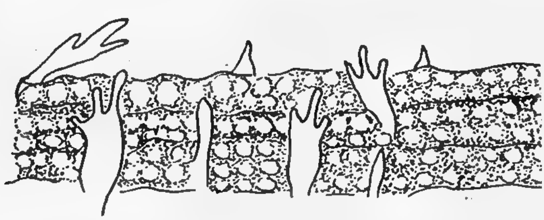
Mantle. Preserved the mantle is creamy-brown reticulated and mottled with dark brown; the papillae are cream-coloured. The mantle surface is plicate, the somewhat irregularly spaced plaits running antero-posteriorly. The papillae are sparse, consisting of two types: small (1 mm. in length), simple, conical processes which are more numerous distally and 10 or 12 larger (2-3 mm.) dendritic papillae which occur proximally. The dendritic papillae rise from a single thick base and then branch into three or more small finger-like processes. The siphonal fringe is short, consisting of 20 evenly spaced serrations; on either side of the siphon there is a cluster of large (2-3 mm.) conical and dendritic papillae.

Radula. The radular ribbon is 16 mm. long, 2 mm. wide, and composed of 288 rows. The teeth are large, sturdy structures which overlap transversely and longitudinally in the anterior portions of the ribbon. The median tooth (.18 mm. long and .24 mm. wide) is semi-circular; the cusps are broad and triangular; and the base is flaring. The anterior dome with cusps occupies two-thirds of the tooth, the cusps forming half of the dome; the cusps terminate evenly, the lateral cusps flaring toward the edges of the tooth. The admedians are of approximately the same dimensions as the median but are rectangular; the central cusp is larger than the lateral cusps and extends about half the length of the tooth body; medially there is a basal cusp which is oriented toward the median tooth but which does not overlap the median. The inner marginals (.15 mm. long; .30 mm. wide) are in the form of an inverted triangle, the base of the triangle consisting of the elongate central cusp which projects over the lateral cusp of the admedians and the shorter lateral cusps, and the apex consisting of the base of the tooth; the lateral cusps of the inner marginals are smaller than the central cusp. The outer marginals (.32 mm. long; .10 mm. wide) are narrow hook-shaped structures with a single central cusp which projects over the inner marginal tooth; a shorter lateral cusp emerges from the anterior quarter of the tooth and projects medially.



1

2



Figures 1 and 2

Figure 1, Mantle surface of *Cypraea argus* Linnaeus.
Figure 2, Mantle surface of *Cypraea vitellus* Linnaeus.

Genitalia. The specimen examined was a female; a bursa copulatrix is present; it is a pyriform structure 8 mm. long and 4 mm. wide.

Distribution. Indo-West-Pacific—from the coast of East Africa to the Line Islands in the Pacific, but excluding the Hawaiian Islands.

Cypraea aurantium Gmelin

Figs. 3, 4; Fig. 6b; Pl. 8, Fig. 1

Material Examined. 1 specimen: length, 93 mm.; width, 62 mm.; height, 53 mm.; from Dahikan coral reef, Manay, Davao, Philippine Islands, June 25, 1962.

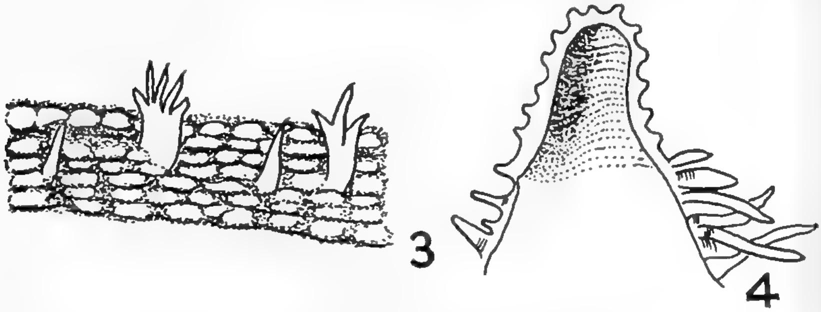
Mantle. Preserved the mantle is grey-black relieved by reticulations of white. The mantle is thick and finely plicate, the plications granulated by small pustules. The papillae are fairly prominent, sparse medially and more numerous near the foot. As in the preceding species there are two types of processes, some small (1 mm.) and simply conical, the others larger (2 mm.) and dendritic; both forms are equally intermingled. The siphon is simply fringed with 20 short, blunt serrations; on each side of the siphon there is a cluster of large, long (3 mm.) conical and dendritic processes; these are more numerous and larger on the left edge of the siphon than on the right.

Radula. The radular ribbon is 75 mm. long, 2.5 mm. wide, and composed of 243 rows. The teeth are massive; the median is .34 mm. long and .21 mm. wide; the admedians are of similar dimensions; the inner marginals are .30 mm. long and .42 mm. wide; the outer-marginals are .30 mm. long and .12 mm. wide. The medians are well-spaced longitudinally with the admedians overlapping the median and the marginals overlapping the admedians transversely and longitudinally. Tooth pattern is as in the preceding species.

Genitalia. The animal dissected was a female, and there is a bursa copulatrix present in the form of an oval structure which swells posterior to the vagina; it is 15 mm. long and 10 mm. in diameter.

Remarks: The dissection of the specimen of *C. aurantium* disclosed two colour features and a structural feature which are noteworthy. The stomach and intestine are black, a colour not previously noted in other specimens of *Cypraea*, and the cerebral ganglia are dark yellow, lacking the red-yellow spotting characteristic of most species of *Cypraea*. The foot is more prominently rugose than in other cypraeids which have been examined.

Distribution. Pacific Ocean-southern Philippines to the Society Islands.



Figures 3 and 4

Figure 3, Mantle surface of *Cypraea aurantium* Gmelin.

Figure 4, Siphon of *Cypraea aurantium* Gmelin.

Cypraea carneola Linnaeus

Fig. 6c; Pl. 8, Fig. 8

Material Examined. Living and preserved specimens from the Hawaiian Islands; preserved specimens from Kenya; Mauritius; Sulu Sea; Tahiti.

Living animal. The mantle is mottled red-brown; the papillae are somewhat lighter in colour than the mantle; the tentacles and proboscis are yellow; the dorsal surface of the foot is light brown. The papillae are sparse; three or four are feathery in appearance while others are simply conical. The siphon projects from the anterior canal as a short, simply fringed structure.

Mantle. Preserved the mantle retains its monotone appearance in Hawaiian specimens; it is mottled cream-white and black in specimens from other areas. The mantle surface is roughly plicate; it is studded with small, conical papillae and fewer, larger dendritic papillae. The siphon is simply fringed with short, tapering serrations; it is bordered by clusters of long conical and dendritic papillae. The siphon and mantle of a preserved specimen were well figured by Vayssière (1923).

Radula. The radular ribbon in six specimens varies from 10-14 mm. in length and from .75 to 1.5 mm. in width, and there are from 140-203 rows. The teeth are conspicuously small; the median is .06-.10 mm. long and .08-.12 mm. wide; the admedians are of similar dimensions; the inner marginals are .07-.09 mm. long and .06-.14 mm. wide; the outer marginals are .10-.15 mm. long and .03-.06 mm. wide. Tooth pattern is as in the preceding species.

Genitalia. A bursa copulatrix is present in the females; it is an oval pouch which extends anteriorly from the reproductive ducts. In the males the penis is a slender conical structure. The lateral basal projection figured by Vayssière (1923) has not been observed.

Distribution. Indo-West-Pacific, including the Hawaiian Islands.

Cypraea leviathan Schilder-Schilder

Fig. 5, Pl. 8, Fig. 9

Material Examined. Living and preserved specimens from the Hawaiian Islands.

Living Animals. The mantle is black, mottled with white; the papillae are cream-coloured and the proboscis and tentacles are black; the foot is grey-brown dorsally, red-brown ventrally. The papillae are numerous, some projecting as feathery tufts from the sides of the animal, others smaller, conical processes. The siphon projects from the anterior canal as a short, simply fringed structure.

Mantle. Preserved the mantle retains much of the black pigmentation noted in living specimens. The mantle surface is plicate and studded with numerous feathery, dendritic papillae which are occasionally interspersed with small, simple, conical papillae. The siphon is simply fringed by a series of short serrations; the siphonal fringe is bordered on each side by a cluster of large dendritic and conical papillae.

Radula. The radular ribbon from four specimens varies from 32-42 mm. in length, from 1-2 mm. in width, and from 206-251 in number of rows. The teeth, especially when compared with those of *C. carneola*, are large and well-spaced both longitudinally and transversely. Dimensions of the median tooth are .10-.16 mm. in length and .18-.25 mm. in width; the admedians are of similar dimensions; the inner laterals are .10-.17 mm. in length and .15-.24 mm. in width; and the outer laterals are .18-.30 mm. in length and .06-.12 mm. in width. Tooth pattern is as in the preceding species. The individual teeth are distinguished from those

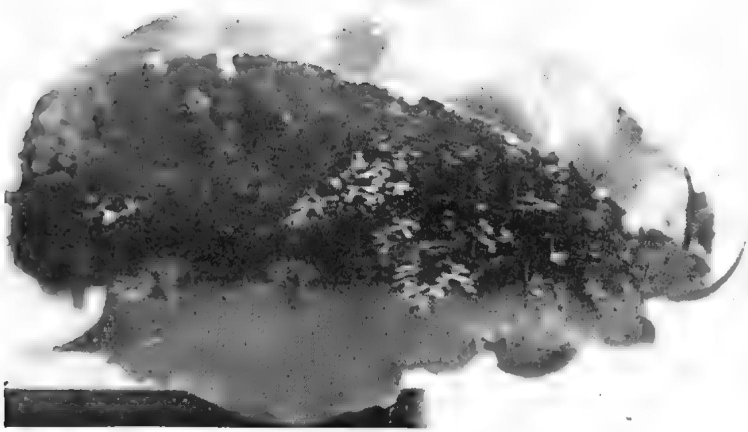


Figure 5

Figure 5, *Cypraea leviathan* Schilder-Schilder. A living animal showing the feathery, dendritic papillae, plicate mantle surface, and short siphon.

of *C. carneola* by their longer and more prominent cusps, and by the obliquely oriented outer marginals with short central cusps. In juvenile specimens the outer marginals are of the hook-shaped type described for the preceding species.

Genitalia. A bursa copulatrix is present in the females; it is a pyriform structure with a bulbous posterior section and a rounded anterior portion. The penis is a simple, elongate, conical structure similar to that in *C. carneola.*

Distribution. Eastern Polynesia exclusive of the Line Islands.

Cypraea lynx Linnaeus

Fig. 6e, Pl. 8, Fig. 2

Material Examined. Living specimens from the Hawaiian Islands and Guam, Marianas Islands; preserved specimens from the Caroline Islands; Fiji; and Marshall Islands.

Living Animals. In living animals from both Guam and the Hawaiian Islands, the mantle is creamy white with splashes of black; the papillae are cream-coloured; the proboscis and tentacles are grey; the siphon is cream-yellow; and the dorsal surface of the foot is cream veined with black. The papillae protrude as densely feathered processes. The siphon is short and simply fringed.

Mantle. The mantle of preserved specimens retains its mottled cream and black coloration. The mantle surface is faintly plicate. The papillae are of two types, smaller, simply conical processes and larger, much branched dendritic structures which appear to be about equally interspersed. A preserved mantle was well figured by Vayssière (1923). The siphon is simply fringed by a row of conspicuously projecting serrations; the siphon is bordered by clusters of densely packed, large conical and dendritic papillae.

Radula. In four specimens the radular ribbon varies from 16-19 mm. in length and from .75-1.25 mm. in width; in a specimen from Fiji there are 183 radular rows and in a specimen from the Hawaiian Islands 225. The teeth are of medium size; the medians are .07-.10 mm. wide and .12-.19 mm. wide; the admedians are of similar dimensions; the inner marginals are .09 to .11 mm. long and .11-.15 mm. wide; the outer marginals are .12-.15 mm. long and .04-.05 mm. wide. The teeth closely overlap one another in the transverse rows but are fairly well-spaced longitudinally. Tooth pattern is as in the preceding species.

Genitalia. A bursa copulatrix is present in the females; it is a heart-shaped structure lying directly below the vagina; in males the penis is a long, slender, conical structure.

Distribution. Indo-West-Pacific, including the Hawaiian Islands.

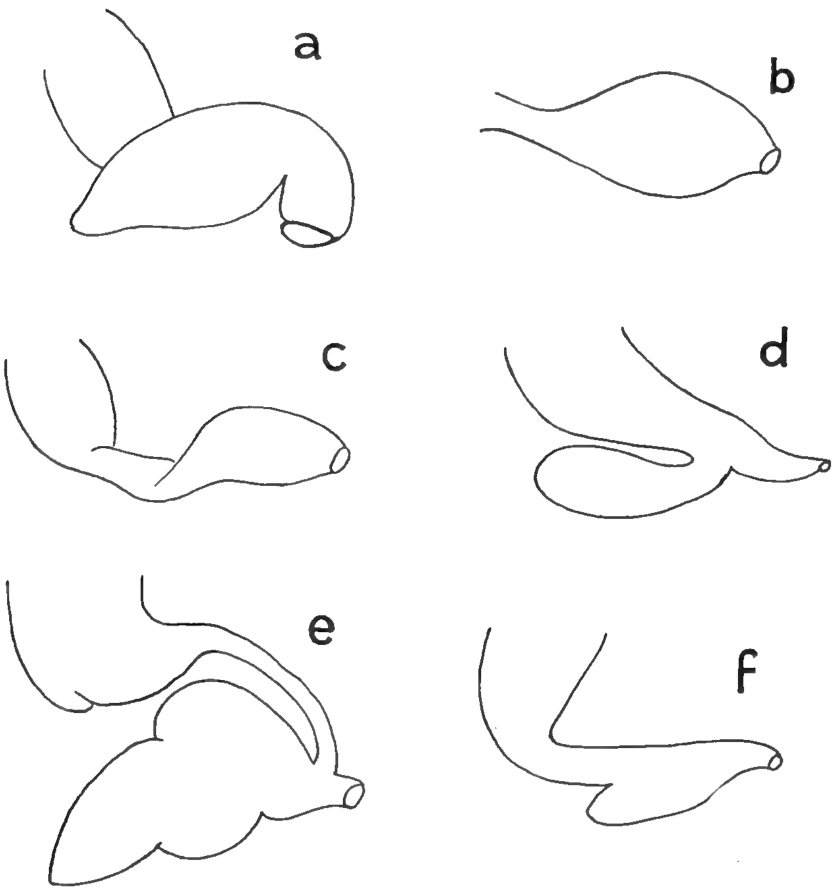


Figure 6

Figure 6, Outlines of the bursa copulatrix. a, *Cypraea argus* Linnaeus; b, *Cypraea aurantium* Gmelin; c, *Cypraea carneola* Linnaeus; d, *Cypraea mappa* Linnaeus; e, *Cypraea lynx* Linnaeus; f, *Cypraea vitellus* Linnaeus.

Cypraea reevei Sowerby

Pl. 8, Fig. 4

Material Examined. Radula of one specimen from Western Australia, June, 1960.

Mantle. Vayssière (1923) described the mantle as having ". . . plis longitudinaux très fins avec papilles simples ou bifurquées peu nombreuses; le bord du siphon pourvu de 24 à 26 papilles fongiformes."

Radula. Neither the length nor the number of rows could be determined from the fragments available; the radular ribbon is approximately 1 mm. wide. Vayssière (1923) noted 200 rows of massive teeth in his specimen. The teeth are sturdy dark brown structures with the medians well-spaced longitudinally and transversely but with the admedians and marginals slightly overlapping. The medians are .16 mm. long and .20 mm. wide; the admedians are of similar dimensions; the inner marginals .13 mm. long and .21 mm. wide; and the outer marginals .24 mm. long and .09 mm. wide. Tooth pattern is as in the preceding species. In the median tooth the anterior dome with its cusps occupies more than three-fourths of the tooth, while the cusps form less than one-fourth of the dome. The form of the tooth is similar to that which Vayssière (1923) figured.

Distribution. South-western and South Australia.

Cypraea schilderorum Iredale

(= *Cypraea arenosa* Gray, 1824)

Pl. 8, Fig. 5

Material Examined. Living and preserved specimens from the Hawaiian Islands.

Living Animal. The mantle is mottled black, brown, and white; the papillae are cream-coloured; the tentacles and proboscis are black; the foot is dorsally light tan and ventrally cream. The siphon projects as a short, simply fringed structure from the anterior canal.

Mantle. Preserved the mantle retains its mottled coloration. The mantle surface is faintly plicate. The papillae are sparse, the smaller conical papillae more numerous than the larger, branched, dendritic processes. The siphonal fringe is prominent, consisting of a single row of stiff serrations; the siphon is bordered by clusters of large conical and dendritic papillae.

Radula. The radular ribbon is 10 mm. long, 0.5 mm. wide, and is composed of 130 rows of teeth. The teeth are small: median .06 mm. long and .08 mm. wide; admedians of the same dimensions; inner marginals .08 mm. long and .09 mm. wide; outer marginals .10 mm. long and .03 mm. wide. The medians are well-spaced longitudinally; the admedians and marginals overlap. Tooth pattern is as in the preceding species.

Genitalia. Males only examined; the penis is the usual slender, tapering conical structure.

Distribution. Polynesia.

PLATE 8

Radulae

Fig. 1, *Cypraea aurantium* Gmelin.
Fig. 2, *Cypraea lynx* Linnaeus.
Fig. 3, *Cypraea sulcidentata* Gray.
Fig. 4, *Cypraea reevei* Sowerby.
Fig. 5, *Cypraea schilderorum* Iredale.
Fig. 6, *Cypraea vitellus* Linnaeus.
Fig. 7, *Cypraea argus* Linnaeus.
Fig. 8, *Cypraea carneola* Linnaeus.
Fig. 9, *Cypraea leviathan* Schilder-Schilder.

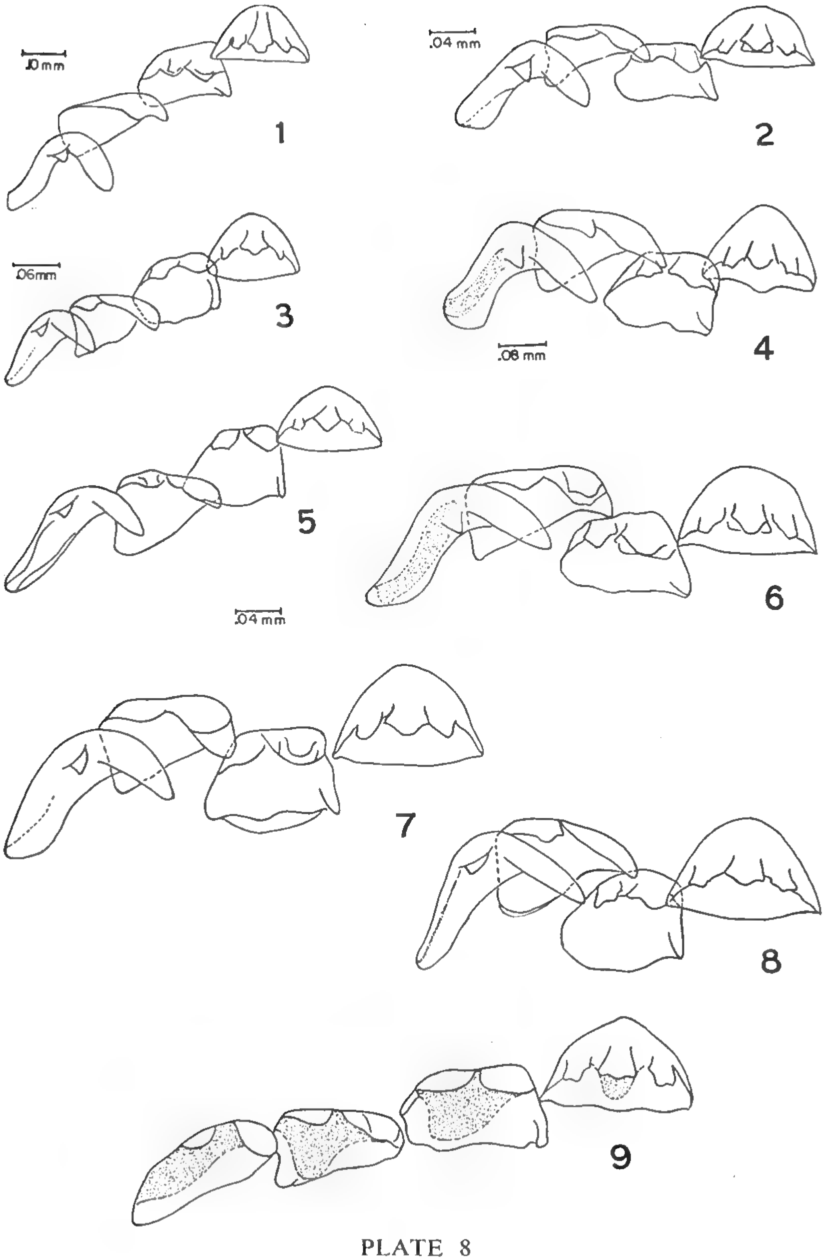


PLATE 8

Cypraea sulcidentata Gray
Pl. 8, Fig. 3

Material Examined. Living and preserved specimens from the Hawaiian Islands.

Living Animal. The mantle is mottled black, brown, and white; the papillae are cream-coloured; the tentacles and proboscis are black; the foot is dorsally light tan, ventrally cream. The papillae project as conspicuous feathery structures from the mantle. The siphon is a short simply fringed process.

Radula. Preserved the mantle retains its mottled coloration noted above. The mantle surface is finely and evenly plicate. The papillae are prominent and numerous; small, conical papillae are more numerous than the thick-set, much-branched dendritic tufts which are scattered over the entire mantle. The siphonal fringe is simple, with a single row of prominent serrations.

Radula. In five specimens the radular length varies from 28-37 mm. and the width from .75-1 mm.; there are 100-260 rows in the radulae examined. The teeth are of medium size; the median is .11-.13 mm. long and .13-.17 mm. wide; the admedian is of similar dimensions; the inner marginals are .12-.14 mm. long and .15-.18 mm. wide, and the outer marginals .13-.18 mm. long and .04-.06 mm. wide. The teeth are closely packed and overlap both longitudinally and transversely. Tooth pattern is as in the preceding species.

Genitalia. There is a pyriform bursa copulatrix in the females; in males the penis is the usual conical structure but the tip is narrowed.

Remarks. Vayssière's (1923) illustrations of mantle and radula of "probably *sulcidenta*" are of a different species; Schilder (1936) has suggested that the figures are of a *C. cinerea.*

Distribution. Hawaiian Islands.

Cypraea vitellus Linnaeus
Fig. 2; Fig. 6f; Pl. 8, Fig. 6

Material Examined. Living and preserved specimens from the Hawaiian Islands and Guam, Marianas Islands; preserved specimens from the Caroline Islands, Lord Howe Island, Australia, Line Islands, Fiji.

Living Animal. In living animals from both the Hawaiian Islands and the Marianas Islands the mantle is cream-coloured and mottled with splashes of black; the papillae are yellow; the tentacles and proboscis are grey and the siphon is cream. The surface of the mantle is covered by fine yellow-grey granules.

Mantle. Preserved the mantle retains its mottled appearance. The mantle surface is plicate and slightly pustulose. The papillae are sparse; small, conical papillae are interspersed among the fewer, larger, much branched dendritic papillae. The pustulose mantle and the two types of papillae were figured by Vayssière (1923). The siphonal fringe is prominent, evenly spaced regular serrations forming the fringe.

Radula. In 12 specimens the length of the radular ribbon varies from 10 to 43 mm. and the width from 1 to 1.75 mm.; the number of rows varies from 164 to 274. The teeth are of medium size; the median is .10-.15 mm. long and .15-.26 mm. wide; the admedians are of similar dimensions; the inner marginals are .10-.14 mm. long and .14-.24 mm. wide; and the outer marginals .14-.24 mm. long and .04-.10 mm. wide. Except in the largest specimen examined, the teeth are well-spaced longitudinally on the ribbon; in all specimens the marginals and admedians overlap. Tooth pattern is as in the preceding species.

Genitalia. A bursa copulatrix is present in the females; in the males the penis is long and slender and, in some specimens, the tip is hook-like.

Distribution. Indo-West-Pacific to the Hawaiian Islands.

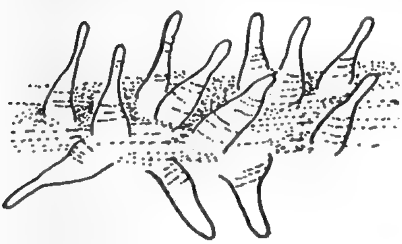
Cypraea mappa Linnaeus

Figs. 6d., 7, 8

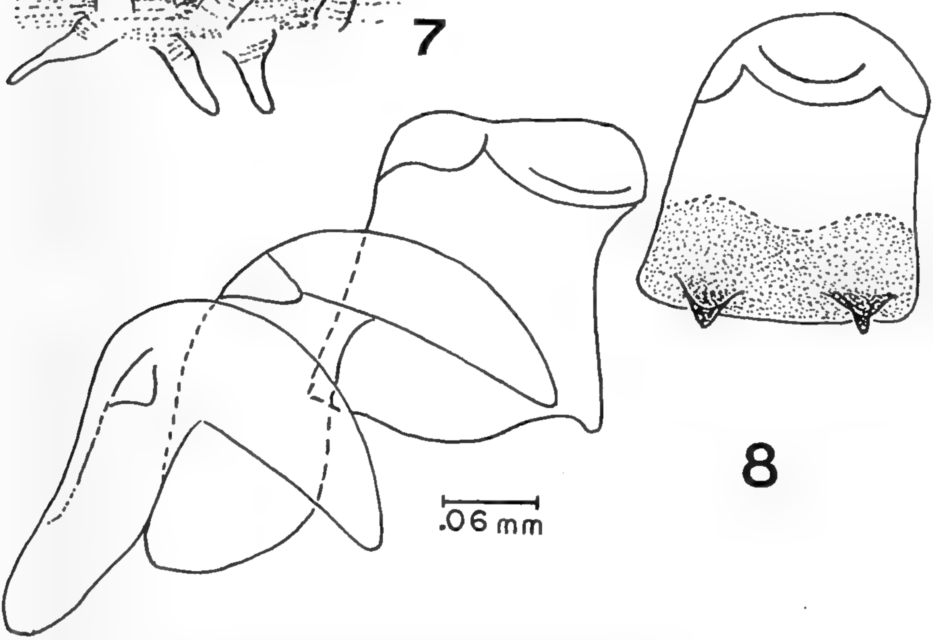
Material Examined. 1 specimen: length, 83 mm., width 59 mm., height, 48 mm.; from Lagoon Reef, Rongutoru, Kapingamarangi, August, 1954; 1 specimen (dimensions not available) from Eniwetok, Marshall Islands, 1959.

Mantle. Preserved the mantle is light fawn with no indication of darker coloration; the papillae are the same colour as the mantle itself. The mantle surface is almost smooth, textured only by irregular, faint rugosities. The papillae are densely scattered over the entire surface of the mantle, consisting of long (2 mm.) conical projections which taper to a fine point at the terminus. The siphon is destroyed in the specimens examined.

Radula. In the specimen from the Marshall Islands the radular ribbon is 55 mm. long, 2 mm. wide, and consists of 158 rows. The teeth are large and sturdy, the medians well-separated from each other, the admedians and marginals overlapping each other in the transverse rows. The median tooth is rectangular, longer than it is broad (.25 x .24 mm.), narrower anteriorly than posteriorly. The central cusp is larger than the lateral cusps. The cusps extend over the anterior one-fourth the tooth body.



7



8

Figures 7 and 8

Figure 7, Mantle surface of *Cypraea mappa* Linnaeus.
Figure 8, Radula of *Cypraea mappa* Linnaeus.

The base is rounded at the corners and bears medially a pair of projecting basal denticles. The admedian is larger than the median (.30 mm. long and .24 mm. wide) and oriented so that the elongate median cusp projects medio-posteriorly; the base is curved, the corners terminating in projecting cusps. The admedian barely overlaps the median tooth but is itself overlapped by the elongate inner marginal which is .33 mm. long and .24 mm. wide; the central cusp of the inner marginal is elongated as a blade-like projection. The outer marginal is similar to the inner marginal but narrower and the central cusp curves more prominently; it is .36 mm. long and .10 mm. wide.

Genitalia. A bursa copulatrix is present in the female; in the Caroline Island specimen the bursa is 9 mm. long, 3 mm. wide, and consists of an oval structure lying posterior to the vagina.

Distribution. Indo-West-Pacific, excluding the Hawaiian Islands.

Cypraea talpa Linnaeus

Figs. 9, 10

Material Examined. Living and preserved animals from the Hawaiian Islands; preserved specimen (62 mm. long, 30 mm. wide), from Kapingamarangi, Caroline Islands, August, 1954.

Living Animals. There is a considerable amount of colour variation in the mantle of specimens observed in the Hawaiian Islands; in one specimen the mantle was fawn with green spots outlined in black; a second specimen was black spotted with minute flecks of fluorescent green; a third specimen was pure black. The papillae are leaf-like projections and the mantle surface is granular. The siphon is not fringed but projects as a smooth process from the anterior canal.

Mantle. Preserved the mantle retains its original coloration to some extent. The mantle surface is conspicuously granular, larger pustules

9

10

Figures 9 and 10

Figure 9, Mantle surface of *Cypraea talpa* Linnaeus.
Figure 10, Radula of *Cypraea talpa* Linnaeus.

representing the contracted papillae and smaller pustules the granular texture noted above in the living animal. The siphon is smooth.

Radula. In the specimen from Kapingamarangi, the radular ribbon is 1.5 mm. wide; the length and number of rows were not determined. The teeth are very broad and evenly spaced but crowded both longitudinally and transversely on the radular ribbon. The median (.06 mm. long and 1.4 mm. wide) is broader than it is long. The central cusp is larger than the lateral cusps; there is a pair of laterally situated basal denticles on the posterior corners of the tooth; and an internal tract is present consisting of a narrow basal portion and wide antero-lateral sections. The admedians and inner laterals are similar to the median in both dimensions and structure. The outer marginals also resemble the median but are wider (.06 mm. long and .21 mm. wide), the central cusp is elongated as a medially oriented blade, and only a single basal denticle is visible.

Genitalia. A bursa copulatrix is present in females, consisting of a pyriform structure; in the specimen from Kapingamarangi the bursa is 5 mm. long and 3 mm. wide. In males the penis is a long, slender, conical structure.

Distribution. Indo-West-Pacific, including the Hawaiian Islands.

Cypraea testudinaria Linnaeus

Figs. 11, 12

Material Examined. 1 specimen: 99 mm. long, 50 mm. wide, 40 mm. height; from Tubajon Bay, Duragit, Philippine Islands, July, 1957 (Zoological Museum of Copenhagen).

Mantle. An observer at Eniwetok, Marshall Islands, has noted that in living animals, "The mantle is absolutely clear, with very long papillae all over it" (Fellows, personal communication). Preserved, the mantle is grey, relieved by cream-coloured papillae; the proboscis and tentacles are black. The mantle surface is comprised of minute rolled ridges separated by thread-narrow grooves. The papillae are sparse but prominent, consisting of elongate nipple-like structures which are evenly distributed over the surface of the mantle. The papillae are broader at the base than at the tip where they taper to a blunt terminus. The majority of the papillae are single structures, but there are occasional bifid papillae which are particularly noticeable near the foot. The siphon is not fringed, consisting of a thick ridge of tissue; it is bordered by a single row of large conical and bifid papillae.

Radula: The radula is a heavy structure with the teeth closely spaced and overlapping. It is 67 mm. in length, 3 mm. in width, and composed of 138 rows. The radula differs from that in other species of *Cypraea* in that the outer marginal teeth are much reduced in size (.21 mm. long, .09 mm. wide) and sculpture, consisting of rudimentary structures which nestle against the well-developed inner marginals. The inner marginals (.45 mm. long, .27 mm. wide) have a blade-like cusp and wide body. The admedians (.51 mm. long, .42 mm. wide) are longer than they are broad, with a single median cusp and reduced lateral cusps. The median (.42 mm. long, .42 mm. wide) is trapezoidal in shape with a blunt median cusp and reduced lateral cusps; the base of the tooth flares into two projecting basal cusps but there are no denticles or internal bracts present.

Genitalia. The animal dissected is a female, and a bursa copulatrix is present. It is an elongate, pyriform structure, 10 mm. in length, and 4 mm. in diameter.

Osphradium and Ctenidium. The ctenidium is the usual horse-shoe shaped structure with one leg longer than the other; the filaments are one-quarter the length of the longer leg. The osphradium is small, less

than one-quarter the length of the ctenidium, and is bifid, consisting of a single long axis with only a vestige of a second branch.

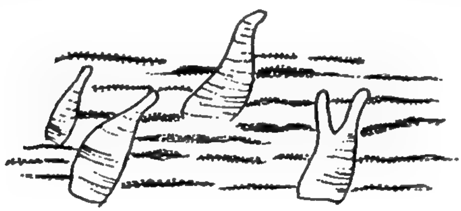
Remarks. I have not had the opportunity to compare Haller's (1890) description of *C. testudinaria* with the specimen described above.

Distribution. Indo-West-Pacific, excluding the Hawaiian Islands.

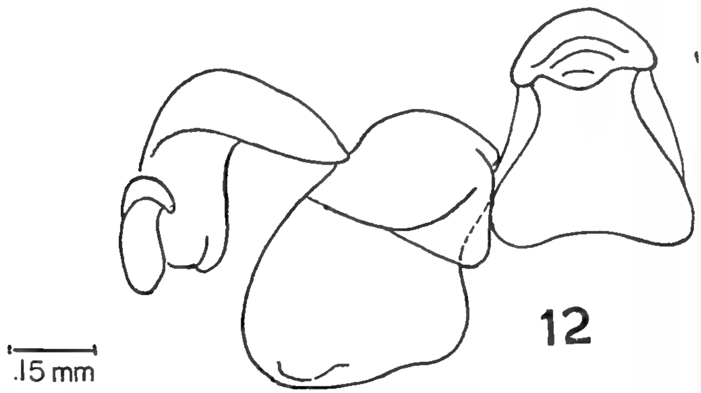
DISCUSSION

Nine of the twelve species described above—*C. argus, C. aurantium, C. carneola, C. leviathan, C. lynx, C. reevei, C. schilderorum, C. sulcidentata,* and *C. vitellus*—are characterized by common features in the radula and mantle, and a bursa copulatrix is present in females of the species. Three—*C. mappa, C. talpa,* and *C. testudinaria*—although bearing a bursa copulatrix in the females, differ in radular pattern and mantle characteristics.

On the basis of radular pattern, the nine species fall into Troschel's subgenus *Lyncina*. Troschel (1863) did not further characterize his subgenus anatomically. The present study discloses these additional features which appear to be common to the cowries bearing rounded or semicircular median radular teeth: the mantle is plicate and occasionally granular; the papillae are of two types, small, conical processes and larger, dendritic tufts; the siphon is short and fringed with a single row of evenly spaced serrations which are of uniform size; and the mantle colour ranges from grey to black or brown, mottled with white or cream, with papillae which are cream or yellow. The cowries which are characterized by these features appear to be restricted to the Indo-West-Pacific; four (*C. argus, C. carneola, C. lynx,* and *C. vitellus*) are widely distributed within the province; three (*C. aurantium, C. schilderorum,* and *C. leviathan*) are limited in their distribution to the Pacific; and one (*C. sulcidentata*) is known only from the Hawaiian Islands.



11



12

Figures 11 and 12

Figure 11, Mantle surface of *Cypraea testudinaria* Linnaeus.
Figure 12, Radula of *Cypraea testudinaria* Linnaeus.

Troschel's subgenus *Lyncina* thus appears to include a group of species which have a number of distinctive anatomical characteristics and which appear to be zoogeographically limited in their occurrence to the Indo-West-Pacific. Of the six species originally proposed by Troschel (1863) as being included in *Lyncina,* four (*C. argus, C. carneola, C. lynx,* and *C. vitellus*) can be included in the more broadly characterized subgenus. Thiele's (1931) removal of *C. mappa* is justifiable on anatomical grounds: with its rectangular median tooth, slightly rugose mantle, and long conical papillae, *C. mappa* is quite distinct from the other species. Thiele's (1931) inclusion of *C. aurantium* is also justifiable on anatomical grounds and I cannot agree with the Schilders' (1938-1939) removal of this species to *Callistocypraea,* which includes *C. testudinaria* among other species. With its rectangular median tooth; long, nipple-like papillae; uniform mantle colour; and bifid osphradium (the only other known species with a bifid osphradium is *C. hesitata*), *C. testudinaria* is anatomically quite distinct from *C. aurantium.* Nor can I agree with the Schilders' (1938-1939) removal of *C. argus* to *Talparia* which includes *C. talpa.* The broadly rectangular median tooth with basal denticles and internal bracts, granular mantle, and smooth siphon of *C. talpa* are again quite distinct from the anatomical pattern which is characteristic of *Lyncina.* Thiele's (1931) inclusion of *C. reevei* in *Lyncina* is justifiable, but on the basis of radular pattern only at the present time; when the mantle and genitalia of this species are examined, they will probably also be found to be of the *Lyncina* type.

The radular pattern recognized by Troschel as characteristic of *Lyncina* is comparable to that I previously described as R4 (Kay, 1960), one of four patterns then distinguishable among the various species of *Cypraea* which I had examined. At that time *C. tigris* was included within the R4 pattern; I now feel the radular teeth of *C. tigris* are sufficiently distinct to be excluded from the pattern. With the exclusion of *C. tigris* from the R4 pattern, all species I previously included in the pattern fall within Troschel's subgenus *Lyncina.*

The recognition of mantle features as characteristic of a group of cowry species is also a departure from views I have previously expressed (Kay, 1960). The very clearly seen association of certain features of the mantle with both radular patterns and genitalia found in *Lyncina* leads me to include these characters in more broadly defining Troschel's subgenus *Lyncina.*

REFERENCES

ALLAN, J., 1956. *Cowry Shells of World Seas.* Melbourne.

HALLER, B., 1890. Die Morphologie der Prosobranchier I. *C. testudinaria. Morph. Jb., 16.*

IREDALE, T., 1935. Australian Cowries. *Aust. Zool.,* 8: 96-135.

KAY, A., 1960. Generic Revision of the Cypraeinae. *Proc. Malac. Soc. Lond.,* 33: 278-287.

SCHILDER, F. A., 1936. Anatomical Characters of the Cypraeacea which confirm the conchological classification. *Ibid.,* 22: 75-112.

————, 1939. Die Genera der Cypraeacea. *Arch. Molluskenk.,* 71: 165-201.

————and F. M. Schilder, 1938-1939. Prodrome of a Monograph on living Cypraeidae. *Proc. Malac. Soc. Lond.,* 23: 119-231.

STEADMAN, W. R., and B. C. COTTON, 1946. A Key to the Classification of the Cowries. *Rec. S. Aust. Mus.,* 8: 503-528.

THIELE, J., 1931. *Handbuch der Systematischen Weichtierkunde.* 2 vols. Jena.

TROSCHEL, F. H., 1856-1863. *Das Gebiss der Schnecken zur Begrundung einer naturlichen Klassification.* 2 vols. Berlin.

VAYSSIÈRE, A., 1923. Recherches Zoologiques et Anatomiques sur les Mollusques de la Famille des Cypraeades. I. *Ann. Mus. Hist. Nat. Marseille,* 18: 1-120.

SOME OBSERVATIONS ON THE LIFE CYCLE OF *VELACUMANTUS AUSTRALIS* (QUOY AND GAIMARD) (GASTROPODA: POTAMIDIDAE)

By Wm. H. EWERS *

Pl. 9, Text figs. 1-5

SUMMARY

The Australian Mud Whelk, *Velacumantus australis,* is common in certain places along the eastern and southern coasts of Australia. Two populations from Narrabeen Lagoon, near Sydney, were studied over the period of one year. Breeding takes place during the summer. Most snails probably breed for the first time at the end of their second year, many die during the next year, but some probably live into their fourth year. Details of the growth of juveniles, and changes in population structure with time, are given.

INTRODUCTION

Velacumantus australis (Quoy and Gaimard) (synonym *Pyrazus australis*), the Australian Mud-Whelk, is common in certain kinds of places along the eastern and southern coast of Australia. It occurs as far north as southern Queensland, and ranges as far as Tasmania and South Australia. Large numbers are often found on sandy mud-flats in the intertidal zone of sheltered bays, estuaries, and in coastal lakes, where it is usually the dominant mollusc. In some places there may be as many as 200 of these snails per square foot. *V. australis* lives in shallow water up to about two feet deep, but deeper waters have not been examined.

V. australis harbours several larval trematodes the adult stages of which live in birds. (Bearup 1955, 1956, 1960, 1961). One of these parasites is the larval stage of the schistosome *Austrobilharzia terrigalensis* Johnston, which normally completes its life-cycle in aquatic birds. The larvae emerge in large numbers from infected snails during the warm summer months and may penetrate the skin of man, producing "Swimmer's Itch" or "Schistosome dermatitis". This condition is not uncommon along the coast of New South Wales in places where the host snail occurs, and is sometimes known locally as "Pelican Itch".

Knowledge of this condition has been summarised by Cort (1950). It has been recorded from many parts of the world, and is caused by a number of different schistosome species most of which live in freshwater snails. Within the last ten years there have been a number of records from marine situations (Chu, 1958). Another dermatitis-producing schistosome occurs in the siphon shells, *Siphonaria* and *Talisiphon,* which live on marine rock platforms around Sydney (Ewers, 1961).

While studying the incidence of the larval trematodes in *V. australis* some observations were made on the life cycle of the snail host. These form the substance of this paper.

---

* School of Public Health and Tropical Medicine, University of Sydney. Adapted from a thesis submitted to the University of New South Wales, for the degree of Master of Science. Some of the data presented were collected while the author was at The School of Biological Sciences, University of New South Wales. I wish to acknowledge a grant from The Post Graduate Medical Foundation, University of Sydney, for a microscope, used in this work. This paper is published with the approval of the Director-General of Health, Commonwealth of Australia.

MATERIAL AND METHODS

1. *The areas studied*: *V. australis* occurs in parts of Narrabeen Lagoon, 16 miles north of Sydney. Two areas of this lagoon were chosen for study and samples of the *V. australis* populations were collected at approximately monthly intervals. Each snail was measured and examined for larval trematodes. A few samples of *V. australis* from other places were also examined.

Narrabeen Lagoon is a shallow estuarine body of water about 2 miles long with several small freshwater creeks running into it. It is usually separated from the sea by a sand-bar, but salt water enters occasionally at high tide or when a channel is deliberately cut through the sand-bar. The salinity of the water varies from time to time. Mostly it is close to that of sea-water, but sometimes is less than half this value. (Bearup, 1955, 1956).

Both the areas studied were near the outlet of the lake between the Pittwater Bridge and the Ocean Street Bridge. A channel runs through this region and it is bounded by sandy mud-flats, with some backwater pools. At times water drains from the lake and these mud-flats are exposed, and the backwater pools become more or less separated from the main channel. Weed beds of *Zostera* cover much of the area.

The two areas studied are designated in the text "The Loftus Street Area" and "The Camping Reserve Area". The Loftus Street Area consists of a shallow backwater of the lake about 100 yards from the shore. It is about 35 yards long and 15 yards wide, almost completely bounded by sand-bars. To the west there is a large sand-flat about 100 yards wide which separates the area from the main channel. The area supports a thick growth of *Zostera,* and during part of the summer, filamentous green algae. The water is usually 9-18 inches deep, but may be up to two feet deep when the water level is very high. At such times the sand-bars and sand-flats surrounding the area are completely under water and the backwater is continuous with the rest of the lake. *V. australis* is the dominant mollusc. *Pyrazus ebeninus,* a closely related species is occasionally found but is extremely rare in comparison with *V. australis.* The juveniles of these two species are difficult to separate, especially when they are very small. Plate 9 shows a series of juveniles and adults of these two species.

The Camping Reserve Area is about half a mile from the Loftus Street Area. It is nearer the sea and close to the Ocean Street Bridge. In this area the shore slopes gently into the main channel. About 30 yards of shore were sampled, all samples being collected within five or six yards of the shore in water up to two feet deep. The area supports a thinner growth of *Zostera* than the Loftus Street Area. *V. australis* is again the dominant mollusc and is much more abundant than at Loftus Street.

One large sample was taken from the beach at Wharf Street, Kogarah Bay. This area is a mud-flat with sandstone outcrops and stones.

2. *Methods of Collecting Samples*: It is easiest to collect *V. australis* at low tide, when they can be seen. However, there is seldom any tidal movement in Narrabeen Lake, and the snails had to be collected by feeling for them while crawling about on hands and knees. A sock hung about the neck is a convenient collecting receptacle, as it leaves both hands free. Very few snails smaller than 10 mm. long were collected by this method. Because of this there are no adequate samples of very young juveniles.

The population at Loftus Street was never very dense and the snails tended to have a patchy distribution. Several snails would often be found close together, and often areas of several square yards were searched without finding a snail. Much of the area was searched each

time a sample was collected, and because the snails could not be seen, collections would seem to be representative of the whole population.

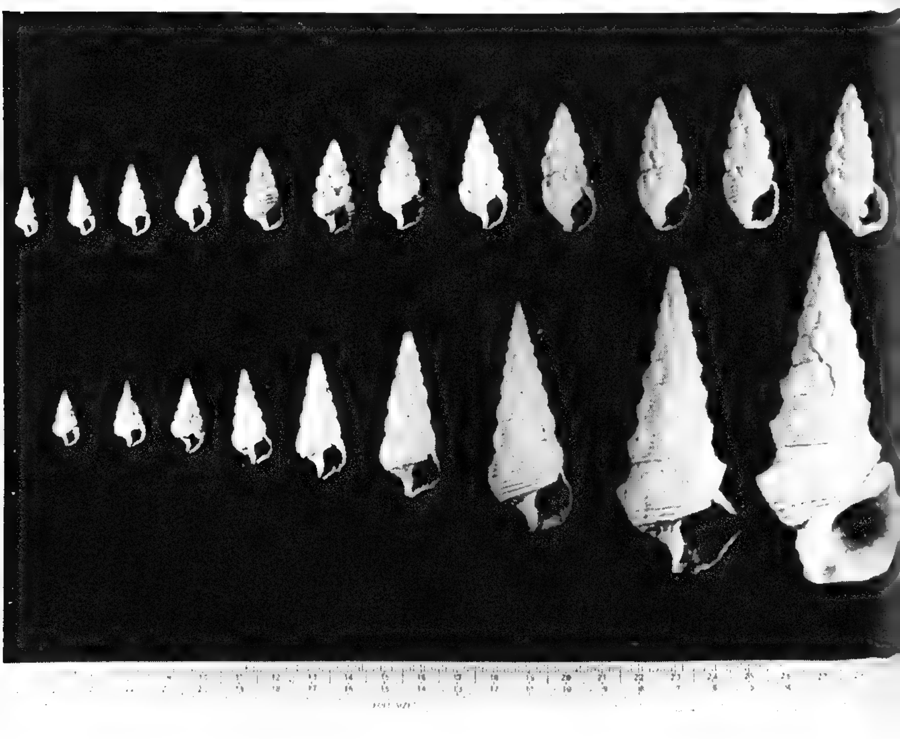
V. australis were very much more abundant at the Camping Reserve Area, and an attempt was always made to collect snails randomly over the whole area.

Originally it was decided to collect 100 snails from each population each month. With the onset of winter adult snails were hard to find, especially in The Loftus Street Area, and some samples were, unfortunately, too small. This was due to several circumstances. Firstly, many adult snails die with the onset of winter, due to senility and probably also the adverse effects of the trematode infections that they harbour. Secondly, the Loftus Street population was depleted by the removal of several large samples taken to provide experimental material. Thirdly, it was often impossible to stay in the water for more than an hour during the winter because of the temperature. On most occasions all snails that were collected were included in the samples irrespective of size.

The snails of each sample were divided into adults and juveniles on the basis of the degree of thickening of the shell. Growth in *V. australis* is apparent as an increase in length until adult length is reached. The lip of the opening of the shell then begins to thicken. The snails do not increase in length very much, if at all, after this thickening starts. All snails which had an unthickened lip were classified as juveniles, all others as adults.

PLATE 9

A growth series of *Velacumantus australis* (Q. & G.) upper row, and *Pyrazus ebeninus* (Brug.) lower row, illustrating the similarity of the young shells and the differences in the adult shells. All specimens from Kogarah Bay, N.S.W. Scale in millimetres.



When the juvenile snails are small it is easy to differentiate them from adults; as they approach maturity it is more difficult. There was probably some variation from time to time, in the classification of adults and juveniles, but I doubt if it has been important. Late in the study the juveniles were differentiated from the adults according to whether the lip of the shell was fragile enough to be broken between the fingers. This method for the differentiation of adults and juveniles seems to be more consistent than visual assessment.

The maximum length of each snail was measured to the nearest millimetre, with a pair of callipers, and after measurement, the snails were examined for larval trematodes.

V. australis can be easily kept in the laboratory in aerated aquaria containing an inch or two of mud from their habitat.

RESULTS AND DISCUSSION

Data on the measurements of juvenile and adult snails are presented in the length-frequency histograms of Figures 1 (Loftus Street) and 2 (Camping Reserve). It would appear that the juveniles belong to one generation and that breeding is confined to a relatively short period of a month or two.

The histograms of Fig. 1 show that the generation of juvenile snails was about 16 mm. long in November, 1959. By January, 1960, the longest of these were as long as the smallest adults in the population. From then on the lengths of juveniles and adults overlap. The length of adult snails ranged from 27 to 47 mm., and the juveniles ranged up to 41 mm. Comparisons of the histograms of juveniles of one month with the histograms of adults for the successive month suggest that by June or July the first juveniles were becoming adults. Many had still not become adult by November, 1960. The histograms for The Camping Reserve Area also suggest that the juveniles of that population were becoming adults by June, 1960.

Figure 3 shows that the proportion of juveniles in both the populations changed in the same way. This is expected in that the two populations were living in very similar neighbouring environments, and could be expected to breed at about the same time and grow at about the same rate. The proportion of juveniles in the population at the Loftus Street Area was higher than in the other population. This was probably due to the large numbers of adult snails that had been removed from The Loftus Street Area for experimental purposes.

The proportion of juvenile snails in the populations increased until July and then decreased. It would appear that up to July many adult snails were dying. From July until September the proportions of juveniles decreased. This must have been because they were changing into adults. Many adults were probably still dying but their numbers were being replaced by juveniles that were reaching maturity. Between September and November the proportion of adults decreased. It would appear that during this period many of the remaining old adults died. At the end of July the incidence of trematode infections in adult snails, reached a peak and these probably caused the death of many adult snails in the next few months. A small number of living specimens are found which appear to be older than the rest of the adults. I think these may well be snails that are in their fourth year.

Dr. J. Clegg of the Australian National University, Canberra (personal communication), has suggested that migration occurs in a population of *V. australis* at Moruya Heads, southern New South Wales. If the snails at Narrabeen do migrate, some of the observations recorded in this paper would have to be interpreted differently. However, it is unlikely that the population at Loftus Street undergoes any migration,

because the area is, for most of the time, virtually landlocked. At no time did I observe any change in the populations at Narrabeen that suggested that migration was occurring.

From December, 1959, until November, 1960, some 80 shells of adults and large juveniles were found in which the spire of the shell had been broken, presumably by a predator. The incidence of these broken shells was highest from May until July. The shells of *V. australis* are hard and thick and it would take a predator with very powerful mouth-parts to break them. The predator may be a crab or fish, or possibly a bird.

Figure 4 shows the average length and standard deviation of juvenile snails taken from Loftus Street. The average length of the first sample

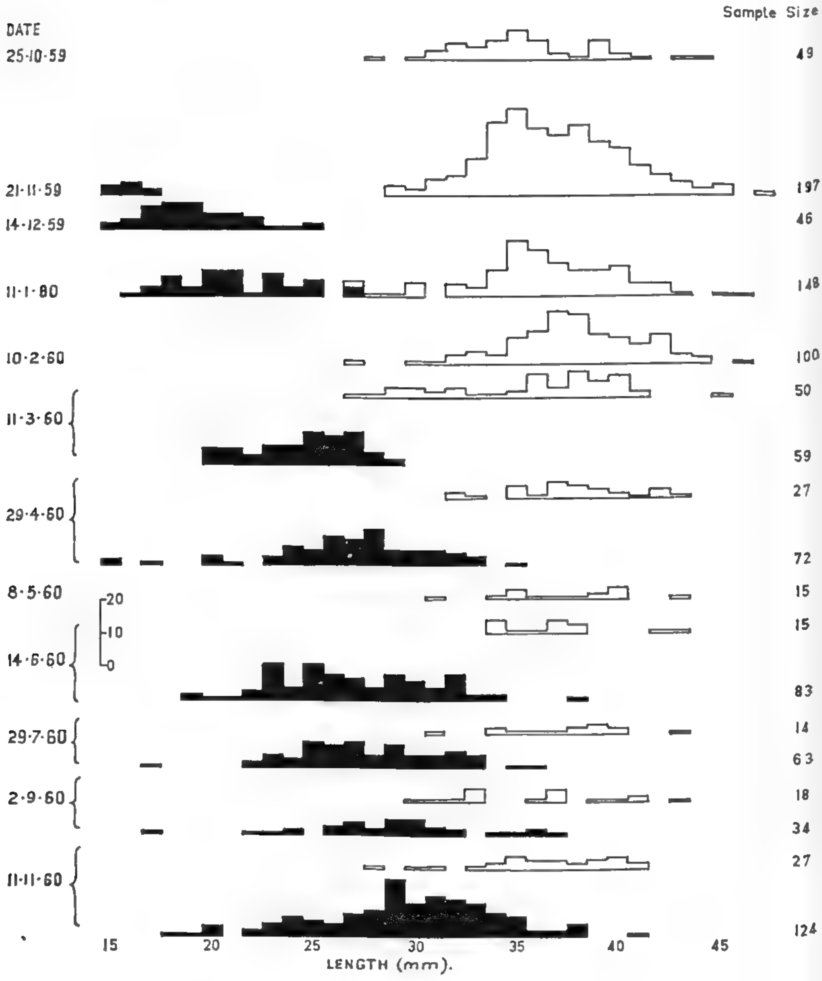


FIGURE 1. Length/frequency histograms of samples of *V. australis* collected from Loftus Street, Narrabeen. [Juveniles solid, Adults line figures]

taken in November, 1959, was nearly 16 mm. There were only 8 snails in this sample and they were probably the largest of the juvenile population at that time, because the very smallest snails would tend to be missed from the samples. Figure 4 shows that the juveniles took about 12 months to grow from an average length of about 15 mm, to 30 mm. While this graph can be expected to follow the usual sigmoid growth curve, its precise mathematical form cannot be determined because no data are available for very young stages. Because of this it is impossible to extrapolate with any accuracy. However, extrapolation would suggest that this generation of snails hatched late in 1958 or early 1959. MacIntyre (1961) states that *V. australis* laid eggs in aquaria during February, so it is likely that breeding occurs sometime during the warm summer months.

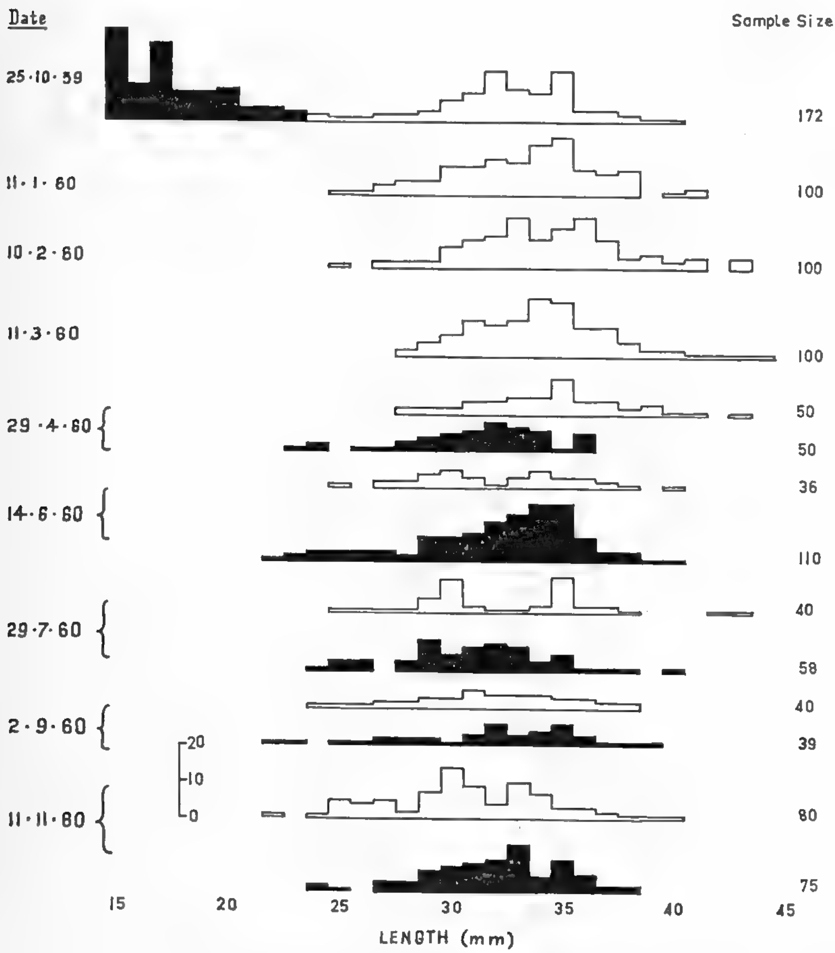


FIGURE 2. Length/frequency histograms of samples of *V. australis* collected from the Camping Reserve Area, Narrabeen. [Juveniles solid, Adults line figures]

Fig. 4 also shows that the rate of increase in length slowed down between May and November. During this period many of the juveniles were changing into adults. There would be a tendency for the longest to become adult first and thus lost to the juvenile population. This would cause a decrease in the growth rate of the juvenile population. When juveniles start to change into adults the anabolic processes, which have previously been concerned with growth in length, switch over to processes concerned with the thickening of the shell lip. This is illustrated by Figure 5 which shows the length/weight relationship of adult and juvenile snails collected from Kogarah Bay. A total of 325 snails (235 juveniles and 90 adults) were measured and weighed after being dried in an oven at 120°C. for about 8 hours. These were selected from about 1000 snails so that, as far as possible, a number of each length were included. Figure 5 shows that the average weight of juveniles is always less than that of adults of the same length. However, there is a good deal of overlapping of the weights of juveniles and adults of the same length as is shown by the data in Table 1. The data in this table are the same as those used in Figure 5.

The largest juveniles from Kogarah were only 2 mm. shorter than the largest adults in the same population. Over the whole period of study, 87% of the adults from The Loftus Street Area and 98% of them from The Camping Reserve Area were within the size range of the juvenile population. The largest adults taken from these areas were 47 mm. long. At times when adult snails were comparatively scarce, it is possible that due to personal inconsistency, some of the longer snails that had started to thicken were classified as adults. At other times some of these same snails would probably have been classified as juveniles.

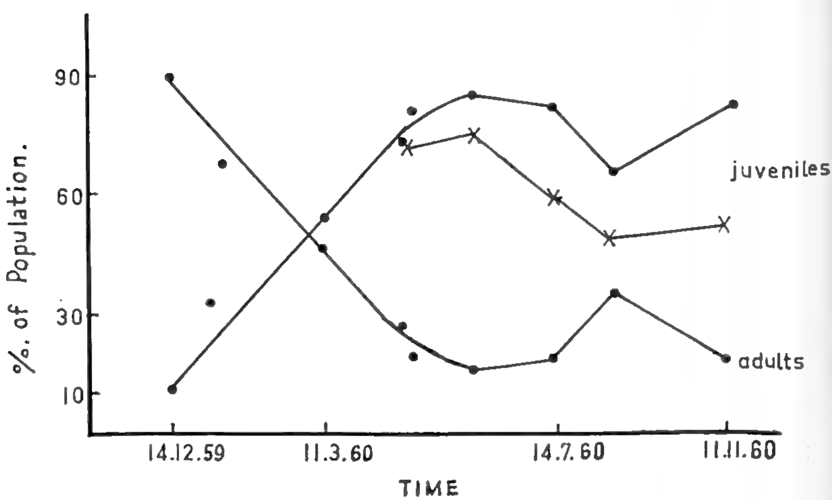


FIGURE 3. Changes in the proportion of juvenile and adult snails, with time, in the populations at Loftus Street (●) and the Camping Reserve (x), Narrabeen.

It would appear that young *V. australis* snails increase in length and weight in a regular fashion up to the time they thicken the mouth of their shells. This may occur any time after they are longer than 27 mm. When this thickening begins the shells must increase in weight quite markedly without increasing in length more than a millimetre. Once the process of thickening is completed a snail cannot increase in length, because growth in length occurs as new shell material is laid down in a spiral at the aperture of the shell. Once the aperture becomes completely thickened further growth in length is impossible.

It is apparent that size is not a good indicator of maturity. There is a minimum length below which no snails are found with thickened shells, but many snails do not start to thicken their shells until they are

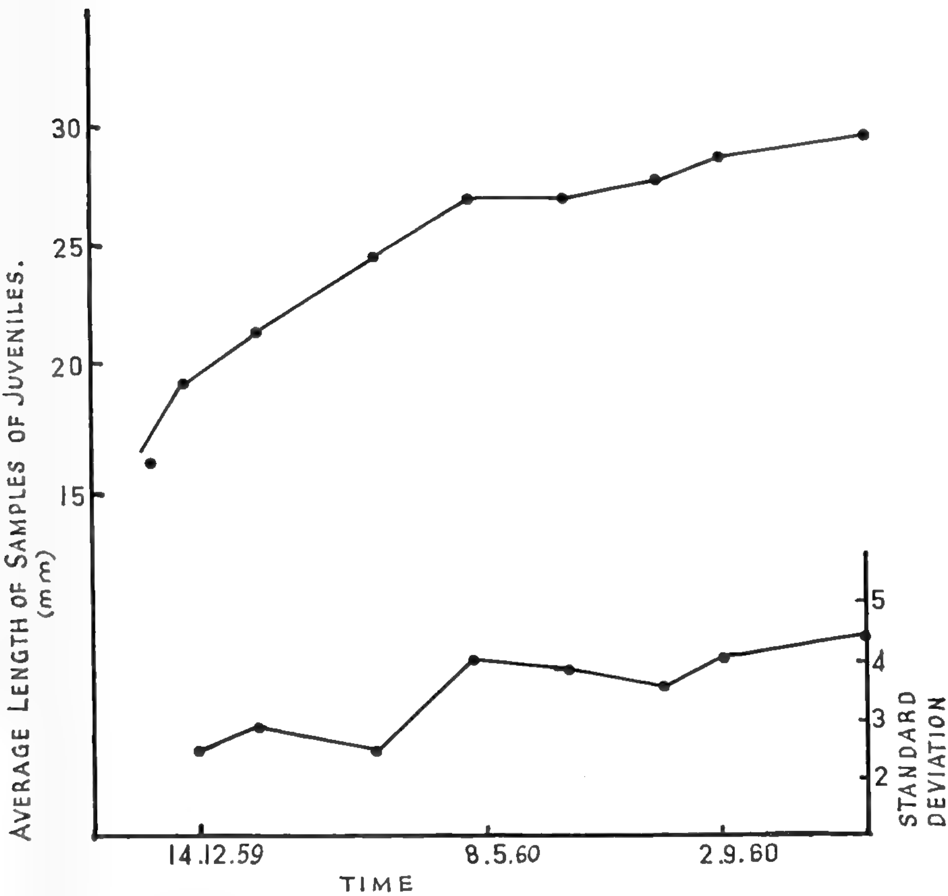


FIGURE 4. The average length and standard deviation of samples of juvenile snails from Loftus Street, Narrabeen, plotted against time.

very much longer than this. It is possible that the onset of the thickening process (of "puberty") is influenced by certain environmental factors, such as some component of weather, so that the new population becomes sexually mature when seasonal conditions are most favourable.

The observations on the life cycle of *V. australis* presented in this paper are very incomplete. This has been inevitable because the investigation was primarily concerned with the larval trematodes in this snail, and not with its life cycle as such. However, in view of our limited knowledge of the life cycles of marine molluscs, it was considered that sufficient data were available to warrant publication.

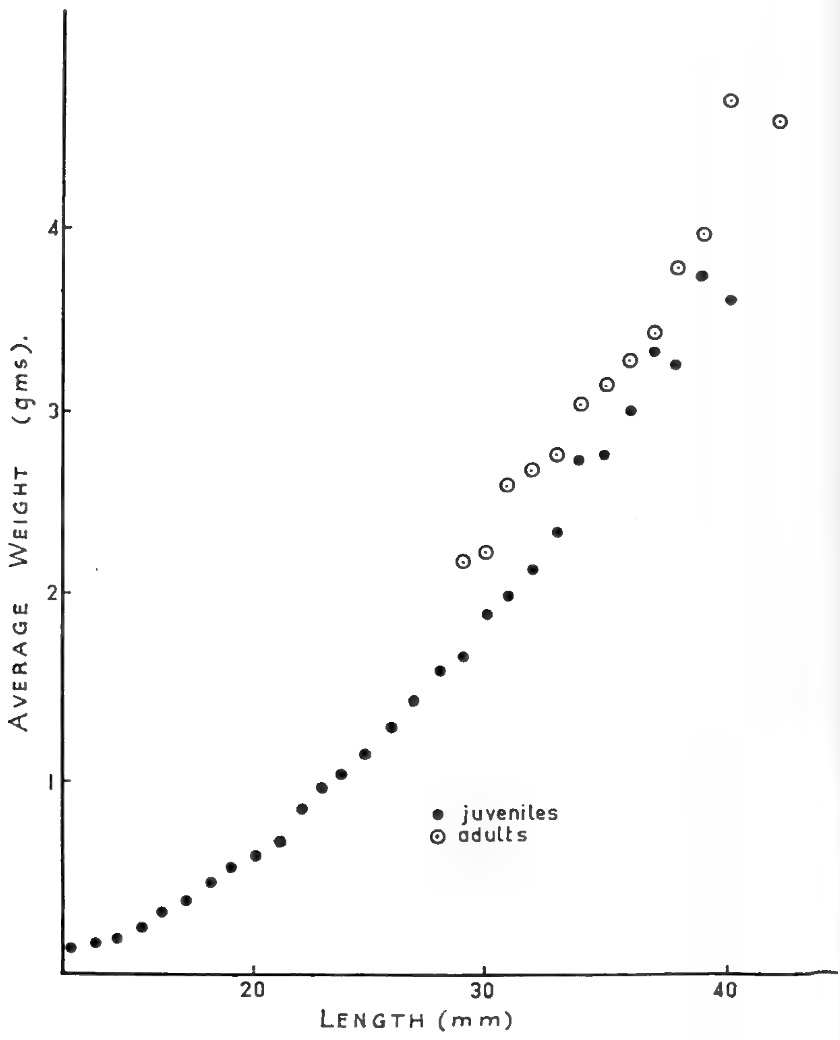


FIGURE 5. The Length/Weight Relationship of *V. australis* snails from Kogarah Bay.

TABLE I

length (mm.)	JUVENILES weights (gms.) Average	range	Number in sample	ADULTS weights (gms.) Average	range	Number in Sample
29	1.65	1.43 - 1.82	12	2.17		1
30	1.87	1.57 - 2.09	9	2.22		1
31	1.98	1.70 - 2.15	10	2.57	2.17 - 2.76	5
32	2.11	1.65 - 2.34	10	2.66	2.20 - 3.13	10
33	2.33	2.13 - 2.77	6	2.77	2.37 - 3.19	8
34	2.71	2.51 - 3.04	8	3.03	2.55 - 3.73	10
35	2.76	2.04 - 3.22	9	3.13	2.79 - 3.43	14
36	2.95	2.60 - 3.26	9	3.29	2.64 - 3.85	15
37	3.31	3.13 - 3.58	7	3.42	2.68 - 3.86	10
38	3.23	2.97 - 3.40	5	3.77	3.23 - 4.05	6
39	3.72		1	3.96	3.65 - 4.31	6
40	3.60	3.59 - 3.60	2	4.70	4.66 - 4.74	2
41			0			0
42			0	4.57	4.06 - 5.08	2

The average weights and the range of weights of juveniles and adults of *V. australis* of various lengths.

The life cycle of *V. australis* may be summarised as follows. Breeding takes place during the summer, probably in a fairly restricted period somewhere between December and March or April. Within about 15-18 months the first of the juvenile population have thickened their shells and become adults. By the end of two years all the juveniles have probably become adults, and they breed towards the end of the second year. After becoming adults the snails do not increase in length. Many adults probably die within twelve months after breeding, that is before they are three years old. Some probably live into their fourth year. The snails do not become infected with larval trematodes until they are approaching maturity, so that the number of snails susceptible to trematode infection increases, as each generation becomes adult.

REFERENCES

BEARUP, A. J., 1955. A schistosome larva from the marine snail *Pyrazus australis* as a cause of cercarial dermatitis in man. *Med. J. Aust.*, June 25, 1955: 955.

BEARUP, A. J., 1956. The life cycle of *Austrobilharzia terrigalensis* Johnston 1917. *Parasitology,* 46: 470.

BEARUP, A. J., 1960. Life History of *Acanthoparyphium spinulosum* Johnston 1917. (Trematoda: Echinostomatidae). *Aust. J. Zool.*, 8: 217.

BEARUP, A. J., 1961. Observations on the life cycle of *Stictodora lari* (Trematoda: Heterophyidae). *Proc. Linn. Soc. N.S.W.*, 86: 251.

CORT, W. W., 1950. Studies on Schistosome Dermatitis: XI Status of Knowledge after more than 20 years. *Amer. J. Hyg.*, 52: 251.

CHU, G. W. T. C., 1958. Pacific Area Distribution of Freshwater and Marine Cercarial Dermatitis. *Pacif. Sci.*, 12: 299.

EWERS, W. H., 1961. A New Intermediate Host of Schistosome Trematodes from New South Wales. *Nature* (Lond.), 187: 283.

MacINTYRE, R. J., 1961. Larval Development of *Velacumantus australis. Proc. Linn. Soc. N.S.W.*, 86: 183.

INSTRUCTIONS TO AUTHORS

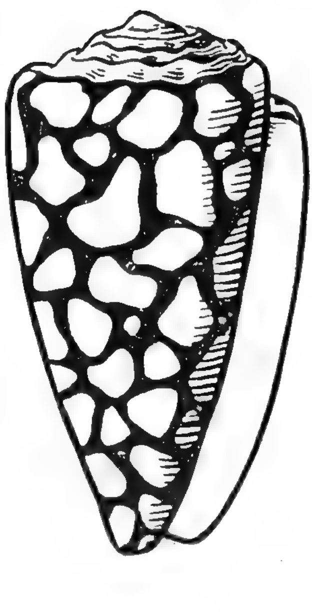
1. It is the responsibility of authors to prepare papers in a form suitable for publication, and they should consult a current issue in order to familiarize themselves with the practices of the *Journal*.
2. No paper shall be published unless approved by the Editor and the Committee.
3. Upon acceptance for publication, the paper, including plates, maps, diagrams and photographs and all copyrights thereof become the property of the Society.
4. Papers should be in double-spaced type-script on one side of the paper only, with 1½" margins. The author's name should appear underneath the title with a footnote indicating the address of the institution (if any) to which he belongs and any necessary acknowledgements. A summary should be included. The original type-script and one carbon copy should be forwarded.
5. As a standard for spelling, the *Journal* uses the *Concise Oxford Dictionary of Current English* (1951, Oxford; Clarendon Press).
6. References should be cited in the text by year of publication, e.g., Leloup (1961) or, if there are several publications by the same author in the same year, Leloup (1961a, 1961b) and they should be arranged at the end of the article in alphabetical order of the authors' names in the following form:

   Leloup, E., 1961. Species of the Genus *Liolophura* Pilsbry, 1893 (Mollusca, Polyplacophora). *J. Malac. Soc. Aust.*, 5: 39-49, pl. 3, text figs. 1-5.

   References to books should give the year of publication, the number of the edition, the town of publication and the name of the publisher. Abbreviations of periodicals should conform with those used in *A World List of Scientific Periodicals* (1952, 3rd ed., London; Butterworth), except that capital initial letters are used throughout. Thus "*J. Malac. Soc. Aust.*"
7. Symbols and abbreviations should conform with those recommended in the Royal Society's publication, *General Notes on the Preparation of Scientific Papers* (1950, Cambridge University Press), e.g., all names which are to be printed in italics (such as generic and specific names) must be underlined in the type-scripts.
8. When possible, a proof will be supplied to the author for correction. Corrections shall, in principle, not include changes from the original text. Such changes may be charged to the author if the Editor deems them to be excessive.
9. A reasonable number of text figures and plates will be reproduced at no cost to the author. Reproduction on special art paper or in colour must, as a rule, be paid for by the author. Full plate size is 6½" by 4" and the maximum width for text figures is 4".
10. Tables should carry a short heading describing the nature of the facts assembled. Both figures and plates, as well as graphs and tables should be fully comprehensible without reference to the text if possible.
11. New taxonomic units of any kind shall be published only if the description is clearly set out and conforms with the requirements of the *International Code of Zoological Nomenclature* (1961, London, Published by the International Trust for Zoological Nomenclature).
12. Descriptions of new species or lesser taxa should not be submitted unless arrangements have been made by the author for depositing the holotype with a recognised public Museum, and Museum numbers of the type specimens should be included in the paper. Type localities should be defined as accurately as possible.
13. The Editor reserves the right to make literary amendments, but authors will see any such amendments before publication.
14. Reprints are obtainable by previous arrangement with the Editor. Twenty-five copies are provided free and additional copies will be charged to authors.

JOURNAL OF THE MALACOLOGICAL SOCIETY OF AUSTRALIA

No. 8



Published 15th December, 1964.

THE MALACOLOGICAL SOCIETY OF AUSTRALIA

1964

Printed by K. A. Wood Pty. Ltd., 61-63 Sussex Street, Sydney, N.S.W. Registered in Australia for Transmission by Post as a Book.

Published annually by the Malacological Society of Australia and obtainable from the Hon. Editor, The Australian Museum, College Street, Sydney, N.S.W., Australia. Price: £1/-/- Australian, or $2.25 U.S. Currency, or 16/- Sterling. Special Rates for Complete Sets.

A PRELIMINARY REVISION OF THE LIVING SPECIES OF *EUCRASSATELLA* (PELECYPODA: CRASSATELLIDAE)

By THOMAS A. DARRAGH*, B.Sc., Dip.Ed.

Pls. 1-3.

SUMMARY

Five species of *Eucrassatella* are recognised. These are *E. kingicola* (Lamarck), *E. donacina* (Lamarck), *E. decipiens* (Reeve), *E. pulchra* (Reeve) and *E. cumingi* (A. Adams). All species are described and illustrated.

INTRODUCTION

During a revision of the Victorian and Tasmanian Tertiary species of *Eucrassatella* Iredale, the author examined the living species of the genus. It was apparent that some confusion existed in the taxonomy and distribution of the various living species and so the author has made a revision based on specimens in the collections of the National Museum of Victoria, the Australian Museum and the South Australian Museum.

The distribution of the various species is taken from labels accompanying the specimens and should be regarded as tentative particularly for the northern coasts of Australia which have been inadequately collected. No records from the literature have been included.

FAMILY CRASSATELLIDAE

Genus *EUCRASSATELLA* Iredale.

Eucrassatella Iredale, 1924, *Proc. Linn. Soc. N.S.W.*, 49, (3):202. Type species (original designation): *Crassatella kingicola* Lamarck, 1805.

Shell thick, heavy, equivalve, ovate to sub-oblong, occasionally subquadrate, posterior end produced. Ornament of concentric ribs usually confined to the umbonal region but occasionally entirely absent or extending to the ventral margin of the valves.

Hinge with a large triangular resilifer. Tooth formula:

$$\frac{3a \quad 3b \quad 5b \quad LPI}{LAII \quad 2 \quad 4b}$$

Epidermis dark, grey to brown. Interior of shell white with patches of colour on the hinge and posterior margin including the posterior adductor muscle scar.

KEY TO THE SPECIES OF *EUCRASSATELLA*

Shell without concentric ornament or with a few weak concentric ribs	*donacina*
Shell with prominent concentric ribs:	
Ribs confined to the umbonal region	1
Ribs extending over the major portion of the valves	2.
1. Umbos low, rounded, rose coloured. Shell without brilliant rays	*kingicola*
Umbos pointed. Surface of valve brilliantly rayed . . .	*decipiens*
2. Shell completely covered with coarse, strong ribs . . .	*pulchra*
Ribs fading out near the ventral margins of the valves and on the posterior area	*cumingi*

* Geology Department, University of Melbourne, Parkville, Victoria.

Eucrassatella kingicola (Lamarck, 1805).
Pl. 1, fig. 1; Pl. 2, fig. 7, 10.

Crassatella kingicola Lamarck, 1805, *Ann. Mus. Hist. Nat. Paris,* 6:409. For synonymy, see Lamy, 1917, p. 205.

Shell elongate to ovately wedge-shaped, posterior side rounded slightly attenuated. Umbos low and rounded, ornamented with 10-15 ribs which fade out 1-2 cm. from the beak. Epidermis grey to brown. Beneath the epidermis the umbos are rose coloured. Interior white with a purple tinge on the posterior margin. Posterior muscle scar dark brown.

Remarks: Lamarck's type specimen is not typical of the species which is generally not so ovate. The validity of the date of the original description has been discussed by Darragh (1964).

Dimensions: Holotype, length 75 mm., height 64 mm.

Type Locality: King Island, Tasmania.

Location of Type: Muséum National d'Histoire Naturelle, Paris.

Distribution: Disaster Bay, Southern New South Wales; Bass Strait: North Coast of Tasmania; Spencer Gulf, South Australia.

Eucrassatella donacina (Lamarck, 1818).
Pl. 1, fig. 4; Pl. 2, fig. 5.

Crassatella donacina Lamarck, 1805, *Ann. Mus. Nat. Paris,* 6:408, *nomen nudum.*

Crassatella donacina Lamarck, 1818, Histoire naturelle des animaux sans vertèbres 5:481, (non var. b).

Crassatella castanea Reeve, 1842, *Proc. Zool. Soc. Lond.,* 10:42.

Crassatella castanea Reeve, 1843, *Conchologia Iconica,* I, *Crassatella,* pl. 1, fig. 3.

Eucrassatella kingicola verconis Iredale, 1936, *Rec. Aust. Mus.,* 19, (5):271. For synonymy, see Lamy, 1917, p. 206.

Shell wedge shaped with prominent umbos and a slightly produced posterior side. The shape varies from an elongate to an ovate shell. Umbos generally smooth, though some specimens show a few very faint fine ribs. Epidermis dark brown to light grey. Beneath the epidermis the shell is yellow to white. Interior white with brown patches on the adductor scars and in the region of the resilifer. Older specimens have a purple tinge around the posterior and ventral margins.

Remarks: The smooth umbos distinguish this species from others of the genus. Originally described by Lamarck without illustration, the species was redescribed and illustrated by Reeve as *Crassatella castanea.* This name has been used by the majority of conchologists. Iredale described *Eucrassatella verconis* from Saint Vincent Gulf, South Australia, separating it from *E. kingicola* but overlooking the fact that *E. donacina* extends into South Australia.

Dimensions: Holotype, length 65 mm., height 52 mm. Type of *verconis,* length 89 mm., height 67 mm.

Type Locality: Shark Bay, Western Australia.

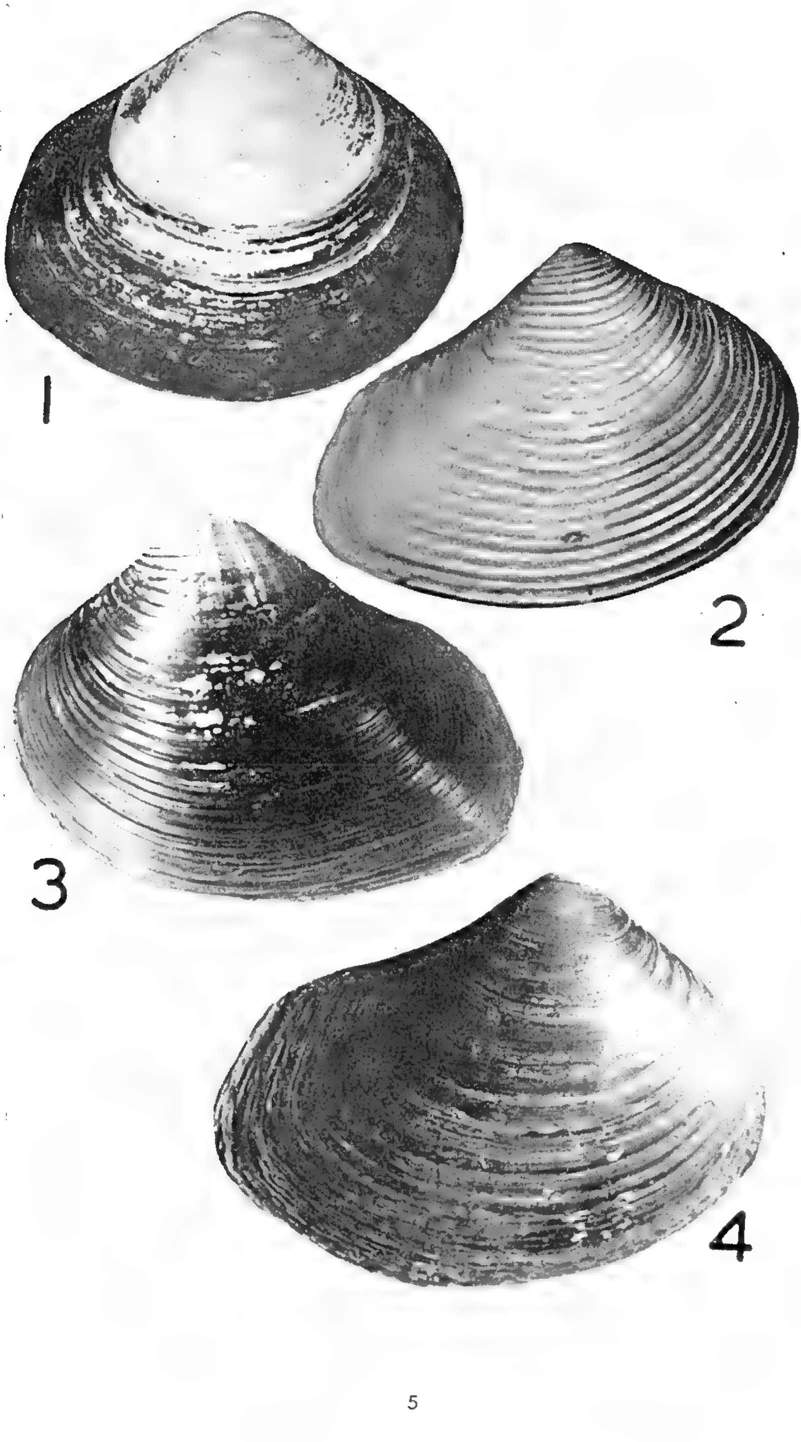
PLATE 1

Fig. 1: *Eucrassatella kingicola* (Lamarck). Holotype, Muséum National d'Histoire Naturelle de Paris; King Island, Tasmania. (x ¾).

Fig. 2: *Eucrassatella pulchra* (Reeve). Holotype, British Museum (Nat. Hist.). (x 1).

Fig. 3: *Eucrassatella decipiens* (Reeve). F23835 National Museum of Victoria; "Western Australia?", purchased L. Reeve. (x 1).

Fig. 4: *Eucrassatella donacina* (Lamarck). Type specimen of *Eucrassatella verconis* Iredale; C1412 Australian Museum; Saint Vincent's Gulf, South Australia. (x ¾).


1
2
3
4

Location of Types: Holotype, Muséum National d'Histoire Naturelle, Paris. Type of *castanea,* Museum Stainforth, location unknown. Type of *verconis,* Australian Museum, Sydney, Registered Number C1412.

Distribution: Saint Vincent's Gulf, South Australia; South Australian Bight; King George Sound, Cottesloe, Shark Bay, Western Australia.

Eucrassatella decipiens (Reeve, 1842).
Pl. 1, fig. 3.

Crassatella decipiens Reeve, 1842, *Proc. Zool. Soc. Lond.,* 10:42.

Crassatella decipiens Reeve, 1843, *Conchologia Iconica,* I, *Crassatella,* pl. 1, fig. 4. For synonomy, see Lamy, 1917, p. 207.

Shell elongate, almost equilateral, posterior side attenuated and rather angular. Umbos pointed, ornamented with prominent concentric ribs which extend over the whole valve for about 2 cm. from the beak then fade out except on the anterior third where they persist for another 1 cm. The rest of the valve is ornamented with growth striae alone. Epidermis grey brown beneath which the surface of the shell is brilliantly rayed. The orange brown rays extend from the umbo to the ventral margin of the valves. Interior white with a purple brown patch on the posterior adductor scar.

Remarks: This shell is generally more equilateral than *Eucrassatella kingicola* and has more pointed umbos. The umbonal ribs also extend further down the shell from the beak.

Dimensions: "Long. 2½, Alt. 2⅛ poll." (inch) Reeve, 1842, p. 43. Figured specimen, length, 65 mm., height 50 mm.

Type Locality: "New Holland", Swan River, Western Australia, *fide* Iredale, 1924, p. 203. The locality "Swan River" would mean the specimens were sent from the Swan River Colony.

Location of Type: Museum Stainforth, location unknown.

Distribution: King George Sound, Cottesloe, Western Australia.

Eucrassatella pulchra (Reeve, 1842).
Pl. 1, fig. 2.

Crassatella sulcata Lamarck, 1818, Histoire naturelle des animaux sans vertèbres 5:481, non Lamarck, 1805.

Crassatella pulchra Reeve, 1842, *Proc. Zool. Soc. Lond.,* 10:43.

Crassatella pulchra Reeve, 1843, *Conchologia Iconica,* I, *Crassatella,* pl. 3, fig. 16.

Shell wedge shaped with prominent pointed umbos, posterior side very much attenuated and produced. Ornament of coarse concentric ribs which fade out on the posterior surface of the shell a little way down from the umbo. Epidermis dark brown to chestnut beneath which the shell is decorated with brilliant orange-brown rays. Interior white, with a dark brown posterior muscle scar.

PLATE 2

Fig. 5: *Eucrassatella donacina* (Lamarck). Holotype, Muséum National d'Histoire Naturelle de Paris; Shark Bay, Western Australia. (x ⅔).

Fig. 6: *Eucrassatella cumingi* (A. Adams). F25109 National Museum of Victoria; Moreton Bay, Queensland; purchased H. Cuming. (x 1).

Fig. 7: *Eucrassatella kingicola* (Lamarck). Holotype, left valve interior. (x ⅔).

Fig. 8: *Eucrassatella cumingi wardiana* Iredale. Syntype. C58354 Australian Museum; Friday Island, Torres Strait. (x 1).

Fig. 9: *Eucrassatella cumingi* (A. Adams). Type specimen of *Eucrassatella baxteri* Iredale; C6883 Australian Museum; Lord Howe Island. (x 1).

Fig. 10: *Eucrassatella kingicola* (Lamarck). Holotype, right valve interior. (x ⅔).

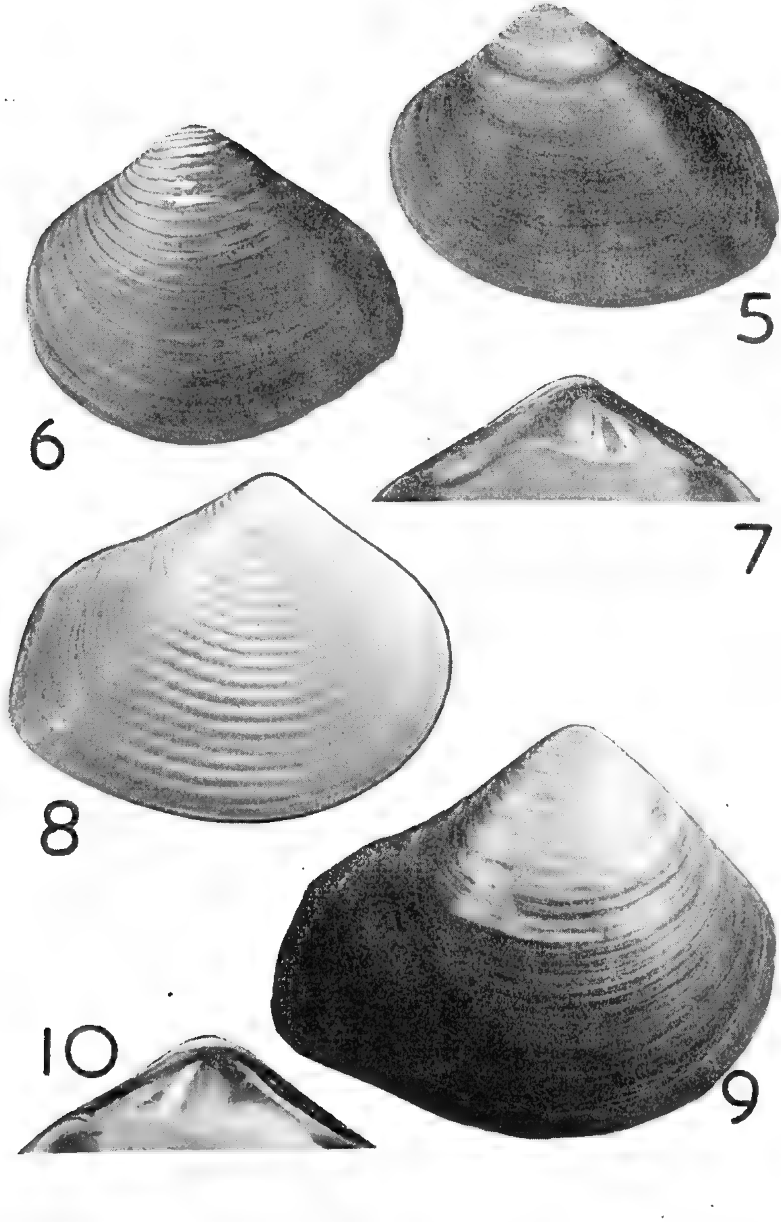


PLATE 2

Remarks: Iredale (1924, p. 203) has indicated the correct usage of *Crassatella sulcata* Lamarck. This species differs from *Eucrassatella decipiens* by having the concentric ribs extend to the anterior ventral margin of the valves.

Dimensions: "Long. 2⅞, Alt. 2 poll" (inch), Reeve, 1842, p. 43.

Type Locality: "New Holland", Port Essington, Northern Australia, *fide* Iredale 1924, p. 203.

Location of Type: Cuming Collection, British Museum.

Distribution: Carnarvon, Onslow, Broome, King Sound, Western Australia.

Eucrassatella cumingi cumingi (A. Adams, 1852).
Pl. 2, fig. 6, 9.

Crassatella cumingi A. Adams, 1854, *Proc. Zool. Soc. Lond.*, 20:90, pl. 16, fig. 1.

Eucrassatella cumingi baxteri Iredale, 1936, *Rec. Aust. Mus.*, 19, (5):272.
?*Eucrassatella genuina* Iredale, 1936, *Rec. Aust. Mus.*, 19, (5):271, pl. 20, fig. 4.

Shell of similar shape to *Eucrassatella pulchra* but ornamented with fewer ribs (12-16 ribs per 2 cm.) which do not extend to the ventral margins of the valves. Epidermis dull brown, beneath which the shell surface is off-white to yellowish white. Interior white with a purple-brown posterior muscle scar.

Remarks: Iredale separated the Lord Howe Island shell as a subspecies *E. cumingi baxteri*. Only 5 valves were available for comparison. This subspecies does not appear to be distinct from *E. cumingi cumingi* except that *baxteri* has more ribs per cm. which extend to the ventral margin of the valves. A larger series of specimens will be needed to decide the validity of the subspecies. *E. genuina* Iredale founded on a broken valve (Pl. 3) does not appear to be distinct from specimens of *E. cumingi cumingi*.

11

12

PLATE 3
Figs. 11, 12: *Eucrassatella genuina* Iredale. Holotype. C60602 Australian Museum; Sydney Harbour, N.S.W. (x ⅘).

Dimensions: Type of *baxteri*, length 61 mm., height 50 mm. Figured specimen, length 49 mm., height 41 mm.

Type Locality: Moreton Bay, Queensland.

Location of Types: Holotype, Cuming Collection, British Museum. Type of *baxteri* Australian Museum, Sydney, Registered Number C.6883. Type of *genuina* Australian Museum, Sydney, Registered Number C.60602.

Distribution: Crescent Head, Tweed Heads, Northern New South Wales; Moreton Bay, Townsville, Green Island, Northern Queensland.

Eucrassatella cumingi wardiana Iredale, 1936.
Pl. 2, fig. 8.

Eucrassatella cumingi wardiana Iredale, 1936, *Rec. Aust. Mus.*, 19, (5): 271.

This subspecies is very close to *E. cumingi cumingi*, only differing in the ribbing which extends to the ventral margin of *E. cumingi wardiana* but generally fades out before reaching the ventral margin in *E. cumingi cumingi*. The posterior end of *wardiana* is not as produced as that of *cumingi*. Unfortunately only a few specimens from the one locality were available for comparison; a larger series may show that *wardiana* is not worthy of subspecific distinction. *E. cumingi wardiana* differs from *E. pulchra* in having coarser and fewer ribs (12 per 2 cm. as to 16 per 2 cm.) and lacks the prominent posterior attenuation and brilliant markings. It is somewhat intermediate in shape and sculpture between *E. pulchra* and *E. cumingi cumingi*.

Dimensions: Syntypes, left valve, length 51 mm., height 41 mm.; right valve, length 53 mm., height 42 mm.

Type Locality: Friday Island, Torres Strait, Northern Australia.

Location of Syntypes: Australian Museum, Sydney; Reg. No. C.58354.

Distribution: Type Locality.

ACKNOWLEDGMENTS

The author wishes to thank Miss J. H. Macpherson of the National Museum of Victoria for her help throughout the work and for arranging loans; Dr. D. F. McMichael for loan of specimens and for photographs of type specimens; Miss H. Laws of the South Australian Museum for loan of specimens; Dr. J. M. Gaillard of the Muséum National d'Histoire Naturelle de Paris for photographs; Professor E. Binder of Geneva for information concerning Lamarck's specimens, and Dr. E. Alison Kay for help in locating types at the British Museum (Nat. Hist.).

REFERENCES

DARRAGH, T. A., 1964. Revision of the species of *Eucrassatella* and *Spissatella* in the Tertiary of Victoria and Tasmania. *Proc. Roy. Soc. Vict.*, 78 (In press).

IREDALE, T., 1924. Results from Roy Bell's Molluscan Collections. *Proc. Linn. Soc. N.S.W.*, 49: 179-278, pl. 33-36.

LAMY, E., 1917. Révision des Crassatellidae vivents du Muséum d'Histoire Naturelle de Paris. *J. Conchyliol.*, 62, (4): 197-270, pl. 6.

EXPLANATION OF PLATES

Figures 1, 5, 7 and 10 are Muséum National d'Histoire Naturelle de Paris photographs. Figures 4, 8, 9, 11 and 12 are Australian Museum photographs. Figures 3 and 6 are photographs taken by the author. Specimen illustrated as figure 3 was purchased from Reeve, the author of the species concerned. The specimen illustrated in figure 6 was purchased from the Cuming collection and identified by Cuming himself. Figure 2 is a photograph by Dr. E. A. Kay.

DESCRIPTIONS OF AUSTRALIAN EOLIDACEA (MOLLUSCA: OPISTHOBRANCHIA)

2. THE GENERA *NOSSIS, EUBRANCHUS, TRINCHESIA* AND *TOORNA*

By ROBERT BURN ‡

Text figures 1-21.

SUMMARY

A new Acleioproct Cuthonid genus *Toorna* is described from the Australian fauna together with four new species, *Nossis westralis, Eubranchus rubeolus, Trinchesia sororum* and *Toorna thelmae*. Supplementary notes are added for *Trinchesia viridiana* and *T. catachroma* (Burn, 1962, 1963). *Nossis* Bergh (1902) is shown to be a Pleuroproct Coryphellid. *Nossis* and *Eubranchus* are new generic records for Australia.

INTRODUCTION

Subsequent to publication of the first part of this series (Burn, 1963), the writer read with great interest of several proposals to stabilize various Eolidacean generic taxa. Where these effect this part, the nomenclature has been used accordingly. Thus *Trinchesia* is to replace *Catriona*, and *Eubranchus* conforms with its new type concept (Lemche, 1964A, 1964B).

The material examined for this research has been deposited in either the National Museum of Victoria, Melbourne (N.M.V.), or the Western Australian Museum, Perth, depending upon the State of origin. Unless otherwise stated, all material has been collected by the writer.

The writer wishes to thank in particular the Trustees of the Science and Industry Endowment Fund, C.S.I.R.O., for a grant in aid of research on the Australian opisthobranchs. This paper is part of a comprehensive study of the Opisthobranchia of Australia being undertaken by the writer. Due acknowledgment is also made to the Directors and Molluscan Departments of the National Museum of Victoria, Melbourne, and the Australian Museum, Sydney, for assistance with literature and material, and advice in the final preparation of this paper.

SYSTEMATIC SECTION

ORDER NUDIBRANCHIA

SUBORDER EOLIDACEA

SUPERFAMILY PLEUROPROCTA

The primary characteristic of this superfamily is the lateral position of the anus below or outside the branches of the liver. Generally a strong pallial or notal brim separates the sides of the body from the notum but in some of the more advanced genera and species the brim is all but non-existent. There are two families (Odhner, 1939: 50, 54): Notaeolidiidae with indistinct cerata forming a fringe along each side of the body, the renal pore beside the genital aperture and two or more denticulate lateral teeth; Coryphellidae with distinct cerata, the renal pore between the anus and the genital aperture and one (exceptionally two) lateral tooth.

‡ Hon. Associate in Conchology, National Museum of Victoria, Melbourne, Victoria.

FAMILY CORYPHELLIDAE

The few genera of this family are *Coryphella* Gray 1850, *Coryphellina* O'Donoghue 1929 and *Nossis* Bergh 1902. *Chlamylla* Bergh (1885; 1890: 36) is not well defined and *Himatella* Bergh (1890: 36) now *Himatina* Thiele (1931: 453) is a synonym of *Coryphella* (Marcus, 1961: 48). The first two genera are closely related, the former has simple or knotty, the latter posteriorly papillate rhinophores; both genera have the cerata in straight rows in the liver groups. In *Nossis*, the rhinophores are perfoliate and the cerata rise from curved peduncles arranged fan-like in the liver groups.

Genus *NOSSIS* Bergh (1902: 210).

Pleuroproct Eolidacea with a triseriate radula (median and lateral teeth denticulate) and numerous rows of conical denticles on the masticatory borders; with perfoliate rhinophores and tentaculiform foot corners; with unarmed penis; right liver with up to five fan-like peduncles of cerata.

Type species by monotypy: *Nossis indica* Bergh (1902: 210).

Bergh (1902: 209-210) placed *Nossis* in his family Flabellinidae along with the genera *Flabellina* Cuvier 1830, *Pteraeolidia* Bergh 1876, *Samla* Bergh 1900 and *Calma* Alder and Hancock 1855. According to the contemporary classification of the Eolidacea, *Flabellina* and *Samla* together with *Calmella* Eliot (1906: 370) comprise the triseriate pedunculate Acleioprocta Flabellinidae, *Calma* comprises the uniseriate pedunculate Acleioprocta Calmidae, while *Pteraeolidia* belongs to the cuspidate Cleioprocta Favorinidae.

Nossis has a well-developed pallial or notal brim with the anus opening below; therefore it is a Pleuroproct (Odhner, 1939: 50) and cannot be allied with any of the abovementioned genera.

There is a marked instance of generic convergence between *Nossis*, the Acleioproct Cuthonid *Indocratena* Odhner 1940 and the Cleioproct Favorinid *Pteraeolidia* Bergh 1876. In common the three genera have a long slender body, cerata set on fan-like peduncles, perfoliate rhinophores and tentaculiform foot corners. Evidently all three occupy a similar ecological habitat.

Nossis westralis sp. nov.
Figures 1-5.

Material examined: WESTERN AUSTRALIA: Nichol Bay, north of Roebourne, 117° East, 20°40′ South, 22 November 1959, 1 specimen, collector not known, W.A.M. 61-64.

Habitat: Collected along with the dorid *Hypselodoris obscura* Stimpson, therefore probably found under or crawling on rocks in the littoral.

Description: The unique holotype measures 17 mm. in length, 3 mm. in breadth across the notum and 2 mm. high. The cerata are up to 3 mm. long and 0.7 mm. in diameter, the sole is about 1 mm. wide. The slug is a uniform pale blue-green through preservation in the same tube with the predominantly blue *Hypselodoris obscura*, paler cream cnidosacs can be seen here and there among the cerata. The living slug is possibly of a cream colour.

The body (Fig. 1) is long and slender, the small head gives rise to the wide notal brim that is most prominent between the 10 protruding liver groups on each side. Rhinophores (*h*) small, stout and finely (about 30) perfoliate. Tentacles (Fig. 1-2, *d*) short with fine tips and stout collar-like bases. Foot-corners tentaculiform, grooved anteriorly for their whole width; sole narrow with wide thin margins; tail very narrow. Cerata (Fig. 3) widest subapicially, sides straight, cnidosacs (*c*) small, dome-like. The cerata stand in single row upon small fan-like peduncles the ventral end of which hangs free and generally carries 2-3 small cerata buds; the total number of cerata on each peduncle varies from 7-9 in the anterior ones but decreases to 3, 2 and 1 in the small posterior groups.

The right liver comprises a group of 5 peduncles. Shortly behind this is a group of 3 peduncles (first posterior liver group right side) behind which are 8 progressively diminishing peduncles. The genital aperture (Fig. 2, *b*) opens on a low papilla below and between the fourth and fifth peduncles of the right liver. The anus (*a*) opens in front of the lower end of the attachment of the first peduncle, first posterior liver group right side, below the notal brim.

The pale yellow 1 mm. long pyriform jaws (Fig. 4) are very delicate and greatly swollen; as in *N. indica* Bergh (1902: 211) the radular sheath projects posteriorly beyond the jaws. The masticatory borders bear up to 5 series of minute conical denticles (*i*). The radula (Fig. 5) contains 35 series of 1.1.1 teeth including 2 developing series. The broad median tooth (*f*) has a short cusp not protruding beyond the 6-7 lateral denticles each side. The equally broad lateral teeth (*g*) are longer than the median teeth, the curved cusp is finely pointed and on the inner edge near the base are three small denticles.

The penis is unarmed.

Discussion: Hitherto *Nossis* Bergh (1902: 210) has been represented by the type species *N. indica* Bergh (loc. cit.) only. *N. westralis* differs from *N. indica* by a greater number of liver groups and peduncles of cerata, fewer series of denticles on the masticatory borders and differently shaped lateral teeth with fewer denticles.

The anal position in *N. indica* is said to be "between first- and second-third parts of the length of the body" (loc. cit.: 211), a position not readily comparable with that of in front of the first posterior liver group right side as in *N. westralis.* But Bergh's specimens were much smaller (9 and 11 mm. long) and probably had not developed the numerous posterior peduncles. Thus it is suggested that in actual fact the anus opens somewhere below the first posterior liver group right side in *N. indica.*

The specific taxon '*westralis*' is from the colloquial corruption 'Westralia' derived from Western Australia. This species is one of the few Eolidaceans included in the collection of Opisthobranchia of the Western Australian Museum sent to the writer for identification and to be reported upon elsewhere.

SUPERFAMILY ACLEIOPROCTA
FAMILY EUBRANCHIDAE

Not previously recorded from Australia, this family is very similar to the Cuthonidae except that the radula is triseriate. The genera of the family are few and fairly well delimited.

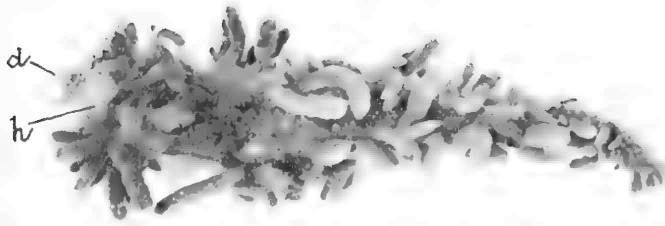


Fig. 1.

Genus *EUBRANCHUS* Forbes (1838: 5).

Acleioproct Eolidacea with a triseriate radula (median tooth denticulate, lateral teeth plate-like without denticles) and a single row of denticles on the masticatory borders; with simple rhinophores and rounded, angulate or tentaculiform foot corners; with penial gland and unarmed penis; right liver with 2-6 simple rows of cerata.

This concept of the genus follows the submissions of Lemche (1964A: 40-44) in which case the type species will be *Eolis farrani* Alder and Hancock (1844: 164).

The only readily visible external characteristics to effectively separate *Eubranchus* from such Cuthonid genera as *Cuthona* and *Trinchesia* that live on the same coastline are (i) the greater thickness of the point of attachment of the cerata to the body and (ii) the position of the tentacles back from the front of the head.

Eubranchus rubeolus sp. nov.
Figures 6-10.

Material examined: VICTORIA: Point Lonsdale, Port Phillip Heads, 144°37′ East, 38°18′ South, 4 November 1963, 1 specimen, N.M.V. reg. no. F23,458.

Habitat: On tips of a brown alga at low tide.

Description: The living slug was 7 mm. in length; preserved it is 3 mm. long including the turned up tail, 1.1 mm. wide and 1.1 mm. high. The medianly folded sole is 0.7 mm. wide over the thickened margins, the cerata are up to 1.1 mm. long. Alive the body colour was white with shining yellow edges to the foot and head, the rhinophores and tentacles were dark red except for a subapicial yellow band and a white cap. On the notum there were 3 round or elongate dark red patches; 3 patches (Fig. 6, *m*) each side correspond with the spaces between the notal patches plus one below the rhinophores. Cerata heavily pigmented; digestive gland dark red for lower four-fifths, white above; cnidosacs white; the skin over the dark red digestive gland is red, over the white part and above it is pale gold with subepidermal white pigment cells. Preserved the coloration consists of yellow body and yellow capped dark red cerata.

Body (Fig. 6) slender; head as wide as body, rounded in front; rhinophores long, tapering and smooth; tentacles short, tapering and

round tipped. Foot-corners rounded, sole as wide as head anteriorly; tail long and slender, round tipped. Cerata (Fig. 7) stoutly fusiform, point of attachment thick; cnidosacs (*c*) small, slender fusiform. Right liver with 2 rows (or a broken arch) of 3, 2 cerata behind which are 3 rows of 3, 2, 2 cerata.

The genital aperture lies below and between the 2 rows of the right liver. The anus (Fig. 6, *a*) opens in front of the dorsal ceras of the first row of the posterior liver right side.

The pale yellow, very delicate 0.7 mm. long jaws (Fig. 8) are elongate; the masticatory borders (*i*) are short with 8-9 overlapping denticles somewhat like those of *Dondice occidentalis* (Engel, 1927; Marcus, 1958: 64, fig. 99). The colourless radula (Fig. 9) contains 95 rows of 1.1.1 teeth. The median tooth (*f*) is small, its cusp insignificant with 3 denticles each side. Each lateral tooth (*g*) is about three times as wide as the median tooth, the cusp at the first quarter is finely pointed and a small notch at the first third is present in the cutting edge.

The short cylindrical penis (Fig. 10, *j*) narrows at the tip but is unarmed. The male atrium (*l*) everts with the penis.

Discussion: Eleven species of *Eubranchus* are listed by Baba (1960: 299), one of which, *E. montraveli* Risbec (1937; 1953: 139), has a penial stylet and therefore cannot be retained in the genus, while another *E. cingulatus* (Alder and Hancock, 1847) is possibly identical with *E. pallidus* (Alder and Hancock, 1842; Lemche, 1935: 144, 1964A: 41). To be added to Baba's list are the species *E. farrani* (Alder and Hancock, 1844; Lemche, 1964A: 41), *E. falklandica* (Eliot, 1907: 353), *E. horii* and *E. misakiensis* Baba (1960: 300). Should the latter species have a penial stylet, it could well be placed in the genus *Capellinia*, the species of which have similar knobbed cerata and penial stylet.

E. rubeolus has only 2 rows of cerata in the right liver with the genital aperture below and between them; in this regard it is similar to *E. rupium* (Moller, 1842; Lemche, 1935: 144, fig. 8a), *E. agrius* Marcus (1959: 72), *E. misakiensis* Baba (1960: 300) and probably *E. falklandica* (Eliot, 1907: 353) which has 6 groups of 4 cerata on each side. Greatly alternating posterior liver rows and a Greenland habitat separate *E. rupium* from the new species; smaller size, differently shaped jaws and radular teeth separate *E. agrius;* tentaculiform foot-corners, the mid-length knobs on the cerata and the peculiar shape of the jaws separate *E. misakiensis;* fewer rows of teeth and narrow triangular lateral radular teeth separate *E. falklandica*.

The great number (95) of rows of teeth in the radula effectively separates *E. rubeolus* from the other species of Baba's list. In colouration, the new species is very much like a figure of a Mediterranean species (Pruvot-Fol, 1951: pl. 4, fig. 2) identified as *E. tricolor* Forbes (1838).

The specific name *rubeolus* refers to the red spotted or measled patterning, from *Rubeola* the medical name of the disease commonly called measles.

FAMILY CUTHONIDAE

SUBFAMILY TERGIPEDINAE

The Tergipedinae are distinguished from the Cuthoninae by the presence of an apicial stylet on the penis (Burn, 1963: 13) and by the greater simplification of the liver ramifications (Odhner, 1939: 75). Based upon the form of the right liver and to a lesser extent the shape of the radular tooth, the genera of the subfamily may be distinguished by the following key.

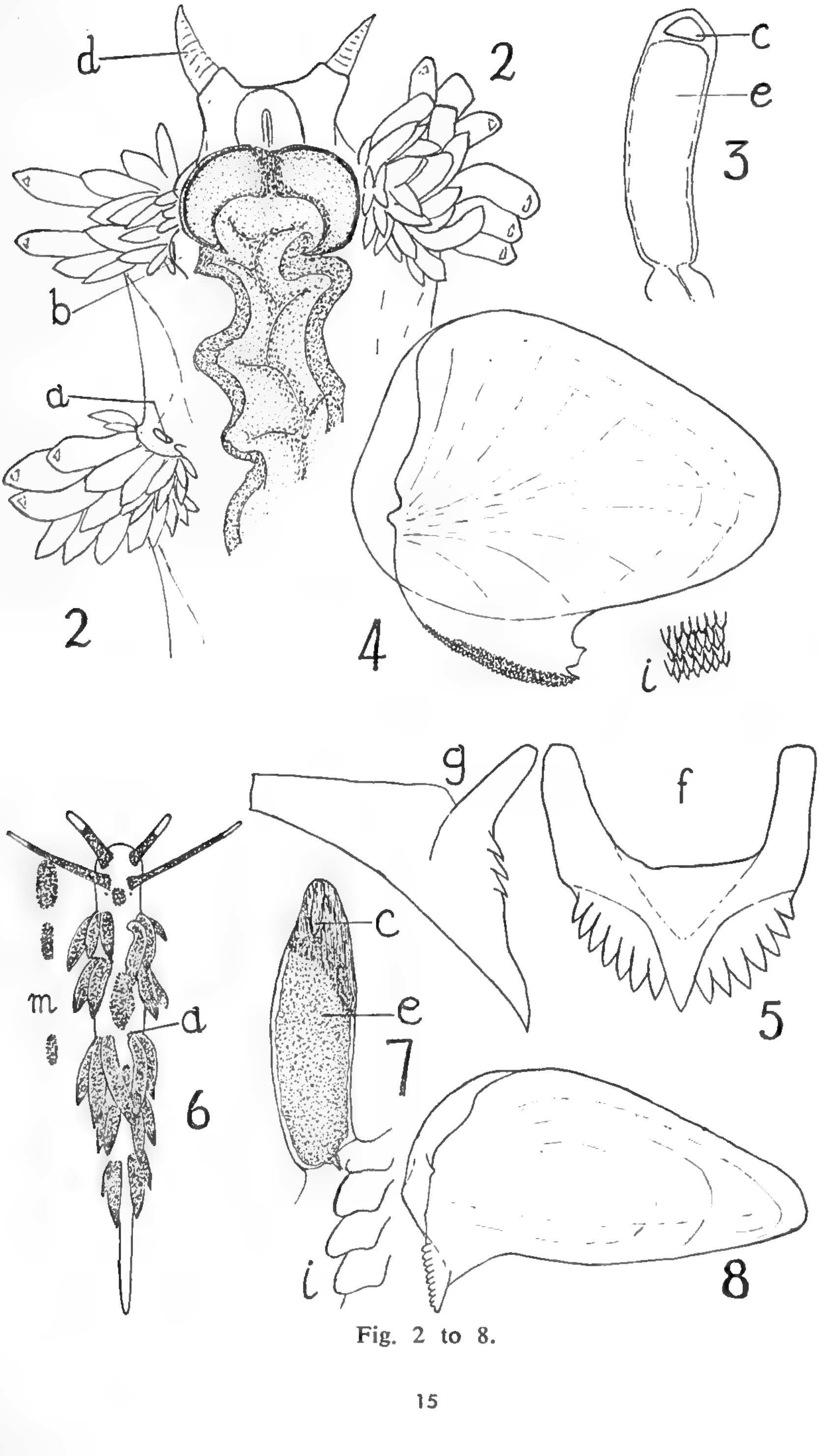


Fig. 2 to 8.

Three (rarely 2) or more cerata in 1-5 rows .... 1.

Two cerata in 2 rows, velum replacing tentacles:
Tenellia A. Costa (1866).

One ceras in 1-3 rows .... 3.

1. Foot-corners rounded or angulate, radular cusp shorter or not longer than lateral denticles .... 2.

   Foot-corners tentaculiform (or rounded), radular cusp longer than lateral denticles .... *Toorna* gen. nov.

2. Radular tooth anteriorly convex, base of cusp on same line as lateral denticles, masticatory border denticulate .. *Trinchesia* Ihering (1879). Radular tooth anteriorly concave, base of cusp protruding beyond rear edge of tooth, minute secondary lateral denticles present, masticatory border with bunches of bristles:

   Catriona Winckworth (1941).

3. Three rows in right liver .... *Subcuthona* Baba (1949).

   Two rows in right liver, velum replacing tentacles:

   Embletonia Alder and Hancock (1851).

   One row in right liver .... *Tergipes* Cuvier (1805).

According to Lemche (1964B), the genus *Trinchesia* Ihering (1879) has priority over and should replace *Catriona* auct. However, as both nominal genera are founded on different type species, *Catriona* Winckworth (1941) does not fall within the synonymy of *Trinchesia*. *Catriona* Winckworth is here maintained as a separate genus characterized by (i) the anteriorly concave radular teeth with the base of the cusp protruding beyond the rear edge and minute secondary denticles between the lateral denticles, (ii) the bunches of bristles on the masticatory borders of the jaws, and (iii) the elongate spermatheca and stalk opening directly into the female aperture. The liver ramifications and genital organs of the type species, *Eolis aurantia* Alder and Hancock (1842: 34) have been figured by Odhner (1929: 19, fig. 15; 1939: 74, fig. 41). Only one other species is known, *C. maua* Marcus and Marcus (1960B: 177).

Genus *TRINCHESIA* Ihering (1879: 137).

According to the earlier research of the writer on *Catriona* auct. (Burn, 1963), now displaced in favour of *Trinchesia* (Lemche, 1964B), this genus is characterized as follows:

Acleioproct Eolidacea with a uniseriate radula in which the cusp is shorter or only as long as the lateral denticles, and with a single row of denticles on the masticatory borders; with simple (rarely annulate or perfoliate) rhinophores and rounded or angulate foot-corners; with penial gland and stylet; right liver with 1-5 simple rows of 3 (rarely 2) or more cerata.

Type species by subsequent designation (Pruvot-Fol, 1954: 380): *Doris caerulea* Montagu (1804: 78).

The recently proposed subgenus *Eurycatriona* Burn (1963: 13) has as its type species *Montagua viridis* Forbes (1840; Odhner, 1939: 72, fig. 37-40). Lemche (1964B: 53) considers *M. viridis* to be identical with *D. caerulea;* therefore *Eurycatriona* is a very junior objective synonym of *Trinchesia*, both as a genus and a subgenus.

The two species formerly ascribed to *Catriona*, *C. viridiana* and *C. catachroma*, are here transferred to *Trinchesia*, and a third species, *T. sororum*, is described below.

Trinchesia viridiana (Burn).

Catriona viridiana Burn, 1962: 111, fig. 13.

Catriona (Eurycatriona) viridiana Burn, 1963: 17, fig. 7-10.

Material examined: VICTORIA: Point Lonsdale, Port Phillip Heads, 14 February 1964, 1 specimen, N.M.V. reg. no. F23,462.

Habitat: Under stone at low tide.

Discussion: The colouration of an 8 mm. long slug from this new locality was yellow-green body with the tentacles and rhinophores distally half green; the cerata had dark green digestive glands topped by small yellow cnidosacs and the whole overlaid by minute white ceratal glands. In other respects, the slug agreed completely with those previously studied.

The discovery of this species at Point Lonsdale, some 40 km. east of the type locality, Torquay, indicates that it is probably widespread along at least the central Victorian coastline.

Trinchesia catachroma (Burn).

Catriona (Eurycatriona) catachroma Burn, 1963: 15, fig. 1-6.

Material examined: VICTORIA: Point Danger, Torquay, 1 December 1963, 1 specimen, N.M.V. reg. no. F23,459; Point Lonsdale, Port Phillip Heads, 22 September 1963, 2 specimens, N.M.V. reg. no. F23,460, 2 January 1964, 1 specimen, N.M.V. reg. no. F23,461.

Habitat: Crawling on brown algae in rock pools or channels at low tide.

Discussion: This additional material shows the species to be fairly constant in coloration. The three Point Lonsdale specimens were identical with the Torquay types except that the cerata had an apicial yellow cap above the distal yellow band, while at the lower third there was another yellow band. Between the two bands, but only on the anterior side, were a few yellow spots and patches. One Point Lonsdale specimen was 11 mm. long alive.

The distribution of this species is probably the same as that of *T. viridiana.* Point Lonsdale is a new locality.

Trinchesia sororum sp. nov.

Figures 11-15.

Material examined: VICTORIA: Point Lonsdale, Port Phillip Heads, 144°37′ East, 38°18′ South, 22 September 1963, 1 specimen, N.M.V. reg. no. F23,463.

Habitat: Crawling on brown alga in large pool on rock platform.

Description: In life the only slug was about 7 mm. long; preserved it is 3.4 mm. long, 1.2 mm. wide and 1.7 mm. high. The sole is 0.5 mm. wide, the cerata are up to 1 mm. long. The living slug had a translucent white body, the tentacles and rhinophores had purple lower halves, the latter with a purple band at the third quarter. The cerata were transparent with orange veined red digestive glands and white cnidisacs. Preserved, the slug is dull plum colour.

Body (Fig. 11) slender and high, head narrow; tentacles short, distally swollen and rounded; rhinophores inversely club-shaped with narrowest part at distal third, distally swollen and rounded. Foot-corners rounded, narrower than head; tail short, tip rounded. Cerata (Fig. 12) cylindrical

with narrower bases and a swelling at the lower part of the cnidosac, conical above; digestive glands (*e*) distinctly (9-10) lobed with alternating venation between; cnidosacs (*c*) slender pyriform, widest at lower third, about one-third total cerata length. Right liver with 3 simple rows of 2, 3, 4 cerata, posterior liver each side with 4 rows of 2, 3, 3, 2 cerata.

The genital aperture lies below the space of the second and third rows of the right liver. The anus (Fig. 11, *a*) is anterior-dorsal to the first ceras of the first row of the posterior liver right side.

The pale horn 0.9 mm. long jaws (Fig. 13) are elongate trigonal, delicate and very little thickened anteriorly. Masticatory borders with 6 pointed denticles, the foremost 3 smaller. The radular teeth were black before boiling in Na OH; afterwards they were colorless. The 24 teeth (Fig. 14) have a fairly wide cusp not longer than the 5 lateral denticles each side.

The short, broad penis (Fig. 15, *j*) that protrudes into the male atrium (*l*) has an 0.1 mm. long, colourless, curved stylet (*n*). The stylet tip is jagged. No penial gland enters either the base of the penis or the male duct close to the penis.

Discussion: *T. viridiana* (Burn, 1962: 111) occurring at the same locality as this new species also has 3 rows of cerata in the right liver, but differs from it in the shape of the jaws and radular teeth, the number of radular teeth and the yellow and green coloration. Similarly, species formerly differentiated from *T. viridiana* (Burn, 1963: 17) are separated from *T. sororum* by the purple pigment on the tentacles and rhinophores, the orange-veined red digestive glands of the cerata and the small number of denticles on the masticatory borders.

The specific name *sororum*, Latin for "of the sisters", is selected to honour Misses F. and M. Murray, Melbourne, whose able collecting has provided the writer with much Victorian opisthobranch material.

TOORNA gen. nov.

Acleioproct Eolidacea with a uniseriate radula in which the cusp is longer than the lateral denticles, and with a single row of denticles on the masticatory borders; with simple or semi-annulate rhinophores and rounded or tentaculiform foot-corners; with penial stylet and long cylindrical vagina; right liver with 3-6 rows of 3 or more cerata.

Type species: *Toorna thelmae* sp. nov.

It is doubtful whether semi-annulate rhinophores and tentaculiform foot-corners are generic characteristics. In the closely allied genus *Trinchesia*, semi-annulate rhinophores are a specific characteristic of *T. pinnifera* (Baba, 1949: 99, 175). On the other hand, annulate rhinophores can be artificially induced in *T. caerulea* (Montagu, 1804) by unusually warm sea temperature (Lemche, 1964B: 54). Normal rhinophores of *T. caerulea* are smooth and cylindrical, i.e., simple. Consequently, species with simple rhinophores should not be excluded from the new genus.

Thus the writer includes the simple rhinophored *Catriona beta* Baba and Abe (1964: 10) in *Toorna* even though it lacks tentaculiform foot-corners. The primary factor for this generic placement is that the prominently cuspidate radular teeth are almost identical with those of *T. thelmae*.

The genital organs of *T. thelmae* have been examined by dissection of the paratype; those of *T. beta* are known from a brief description and three diagrammatic figures (Baba and Abe, 1964:10, pl. 1, figs. 4-6). Both species have apicial stylet, penial gland and prostatic portion of the male duct, and a long cylindrical vagina surmounted by an obliquely angled spermatheca in the female ducts. This formation of the vagina and

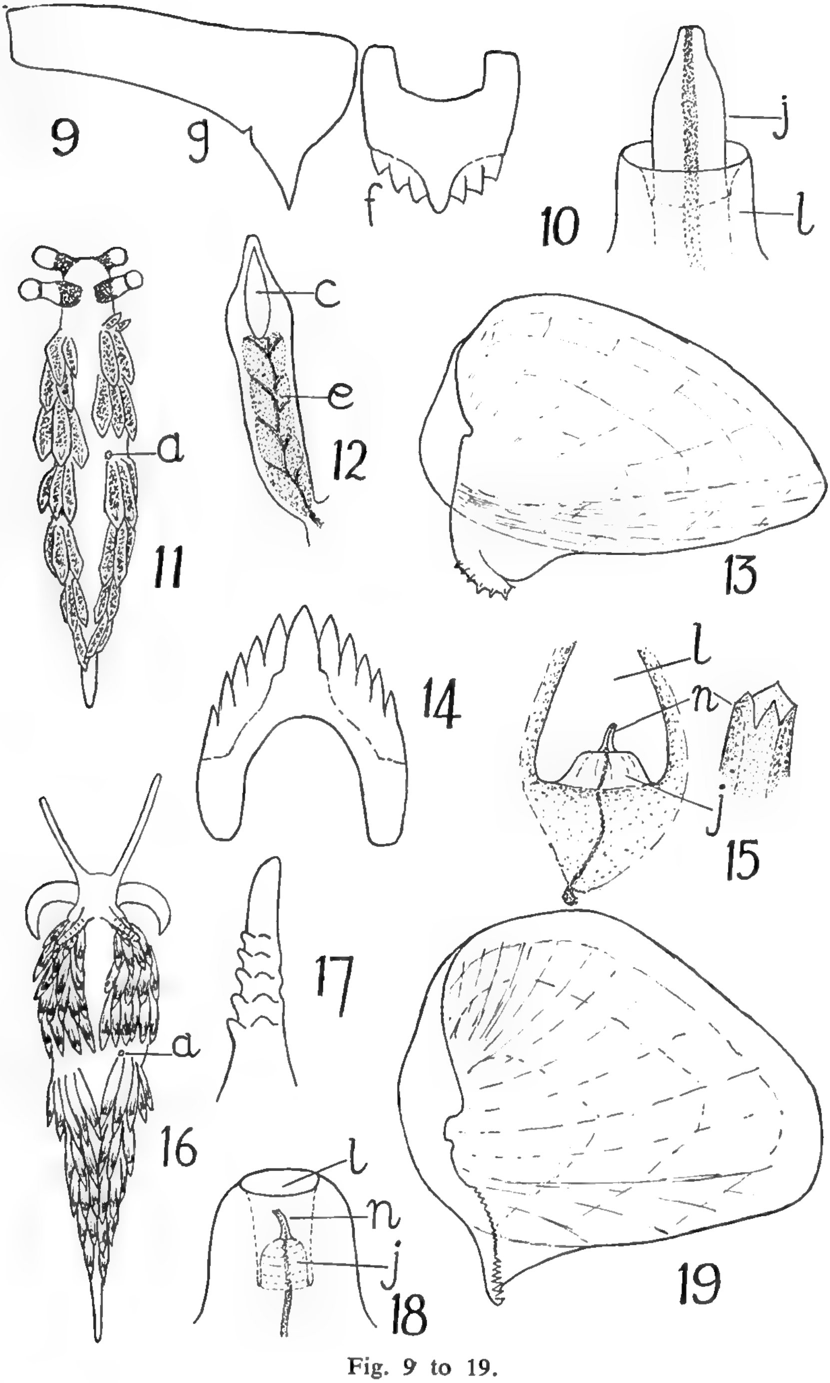


Fig. 9 to 19.

spermatheca is not known in *Trinchesia* or *Catriona* and effectively separates *Toorna* from either genus.

The combination of the characteristics of the genital organs and the prominently cuspidate radular teeth justifies the establishment of a separate generic taxon for these two species.

Toorna is an Australian aboriginal word meaning "sea-slug", probably referring to the bêche-de-mer of commercial value and not to a mollusc.

Toorna thelmae sp. nov.
Figures 16-21.

Material examined: VICTORIA: Point Lonsdale, Port Phillip Heads, 144°37′ East, 38°18′ South, 22 September 1963, 1 specimen, N.M.V. F23,464 (holotype); 24 October, 1964, 1 specimen, author's collection (paratype).

Habitat: Crawling on brown alga in pool on rock platform.

Description: Living slugs measure about 10 mm. in length. The preserved holotype is 4 mm. long, 0.8 mm. wide and 1 mm. high. The cerata are up to 1.3 mm. long; the narrow sole is 0.5 mm. wide at mid-length, 1 mm. across the foot-corners. It had a translucent pink body, darker about the head and tentacles; the rhinophores were pink with the upper half opaque white and the annulae yellow. There were two pale blue patches in front of, one between, two behind and one each side of the rhinophores; smaller pale blue spots occur on the tentacles and along the tail crest. Cerata with orange digestive glands and white cnidosacs; epidermally there was a pale greenish-yellow subapicial band from which descend 4-6 short blue-white stripes. Preserved, coloration is pale pink.

Body (Fig. 16) anteriorly wide, tapering behind; tentacles long and slender; rhinophores (Fig. 17) rather short, tapering, with 5 transverse rows of 3 semi-circular lamellae concentrated in the posterior middle

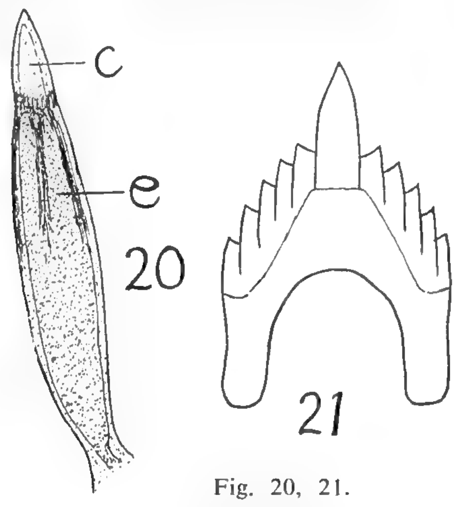


Fig. 20, 21.

half. Foot-corners long and narrowly tentaculiform, sole wider than head, tail long and tapering to a fine point. Cerata (Fig. 20) slender fusiform, slightly constricted at the distal quarter; cnidosacs (*c*) elongate conical, about one quarter length. Right liver with 5-6 simple rows of 2, 4, 4, 4, 5, 6 cerata behind which are 5 rows of 6, 5, 4, 4, 3 cerata.

The genital aperture is below the fourth row of the right liver. The anus (Fig. 16, *a*) is anterior to the first ceras of the first row of the posterior liver right side.

The yellow 0.9 mm. long jaws (Fig. 19) are broadly pyriform and

strengthened anteriorly. The masticatory borders bear 16 pointed denticles. The colourless radula (Fig. 21) contains 33 teeth, each with a long prominent cusp and 5 small denticles each side. The cusp is strongly hooked at the tip.

The male duct of the genital organs is narrow and short when it branches from the hermaphrodite duct. Immediately thereafter occurs a voluminous prostatic dilation which narrows ectally to a short vas deferens below entering the wider long muscular penial sheath. A thin walled pyriform penial gland opens into the penial sheath at the inner end. In the tip of the penial sheath is a small eversible socket, bearing on its inner face a slender curved hyaline stylet (fig. 18, *j*). The female aperture lies beside but quite distinct from the male aperture; there is no common genital atrium. Just inside the aperture is a major bifurcation, the oviduct to the female gland mass and the long cylindrical vagina to the obliquely angled spermatheca. The duct between the female gland mass and the hermaphrodite duct is dilated at mid-length to form a small fertilizing chamber.

Discussion: This species is named to honour Mrs. Thelma W. Hartley, Melbourne, in recognition of her untiring work in the field of administration of the Malacological Society of Australia.

The new species is easily distinguished from *T. beta* by its tentaculiform foot-corners, semi-annulate rhinophores and greater number of rows of cerata in the right liver. The two species also differ in coloration though both have orange digestive glands in the cerata.

REFERENCES

ALDER, J., and A. HANCOCK, 1842. Descriptions of several new species of nudibranchous Mollusca found on the coast of Northumberland. *Ann. Mag. Nat. Hist.,* 9: 31-36.

————, 1844. Description of a new genus of nudibranchous Mollusca, with some new species of *Eolis. Ibid.,* 13: 161-166, pl. 2.

BABA, K., 1949. *Opisthobranchia of Sagami Bay.* 194 + 7 pp. 50 pl. Tokyo (Iwanami Shoten).

————, 1960. Two new species of the genus *Eubranchus* from Japan. *Publ. Seto Mar. Biol. Lab.,* 8 (2): 299-302, pl. 34.

————, 1961. Three new species of the genus *Catriona* from Japan. *Ibid.,* 9(2): 367-372, pl. 14-15.

BABA, K., and A. ABE, 1964. A Catrionid, *Catriona beta* n. sp., with a radula of the Cuthona type. *Ann. Rep. Noto Mar. Lab.,* 4: 9-14, pl. 1.

BERGH, R., 1890. Die cladohepatischen Nudibranchien. *Zool. Jb.,* 5: 1-75.

————, 1902. Gastropoda opisthobranchiata: The Danish Exped. to Siam 1899-1900, I. *K. Danske Vidensk, Selsk.,* (6), *Naturvid. Math. Afd. XII,* 2: 159-218, pl. 1-3.

BURN, R., 1962. Descriptions of Victorian nudibranchiate Mollusca, etc. *Mem. Nat. Mus., Melb.,* 25: 95-128.

————, 1963. Descriptions of Australian Eolidacea, I, The genera *Catriona* and *Herviella. J. Malac. Soc. Aust.,* 7: 12-20.

ELIOT, C., 1906. Notes on some British nudibranchs. *J. Mar. Biol. Ass. U.K.,* 7: 333-382, pl. 11-12.

————, 1907. Nudibranchs from New Zealand and the Falkland Islands. *Proc. Malac. Soc. Lond.,* 7: 327-361, pl. 28.

FORBES, E., 1838. *Malacologia Monensis.* 7 + 63 pp. 3 pl. Edinburgh (John Carfrae and Son).

IHERING, H. von, 1879. *Zool. Anz.,* 2: 137 (not seen).

LEMCHE, H., 1935. On some nudibranchiate gastropods from the northern Atlantic. *Vidensk. Medd. Dansk Naturh. Foren. Kbh.* 99: 131-148.

———, 1964A. *Eubranchus* Forbes, 1838 (Gastropoda): Proposed designation under the Plenary Powers of a type-species, etc. Z.N.(S) 1102. *Bull. Zool. Nom.*, 21(1): 40-44.
———, 1964B. Proposed stabilisation of the generic name *Trinchesia* Ihering, 1879, and suppression under the Plenary Powers of *Diaphoreolis* Iredale & O'Donoghue, 1923. Z.N.(S) 1106. *Bull. Zool. Nom.*, 21(1): 52-55.
MARCUS, E. (and E.), 1957. On Opisthobranchia from Brazil (2). *J. Linn. Soc. (Zool.)*, 43: 390-486.
———, 1958. On Western Atlantic opisthobranchiate gastropods. *Amer. Mus. Novit.* no. 1906: 1-82.
———, 1959. Lamellariacea und Opisthobranchia. Lund Univ. Chile Exped. *K. Fysiogr. Sällsk. Handl.*, N.F. 70(9): 1-135.
———, 1960A. Opisthobranchia aus dem Roten Meer und von den Maldiven. *Abh. Math.-Nat. Kl. Akad. Wiss. Mainz*, 1959, (12): 871-934.
———, 1960B. Opisthobranchs from American Atlantic warm waters. *Bull. Mar. Sci. Gulf and Caribb.* 10(2): 129-203.
———, 1961. Opisthobranch mollusks from California. *Veliger*, 3 (Suppl. 1): 1-85, pl. 1-10.
MONTAGU, G., 1804. Description of several marine animals found on the south coast of Devonshire. *Trans. Linn. Soc. Lond. (Zool.)*, 7: 61-85, 2 pl.
ODHNER, N., 1939. Opisthobranchiate Mollusca from the western and northern coasts of Norway. *K. Norske Vidensk. Selsk. Skr.*, 1939 (1): 1-93.
PRUVOT-FOL, A., 1951. Etudes des nudibranches de la Mediterranee (2). *Arch. Zool. Exp. Gén.*, 88: 1-80, pl. 1-4.
———, 1954. Mollusques opisthobranches. *Faune Fr.*, 460 pp. 1 pl.
RISBEC, J., 1953. Mollusques nudibranches de la Nouvelle Caledonie. *Faune Un. Franc.*, 15: 1-189.
THIELE, J., 1931. *Handbuch der systematischen Weichtierkunde.* 1(2): 377-766. Jena (Gustav Fischer).
WINCKWORTH, R., 1941. The name *Cratena*. *Proc. Malac. Soc. Lond.*, 24: 146-149.

EXPLANATION OF FIGURES

Fig. 1-5. *Nossis westralis* sp. nov.
1. Dorsal view of preserved holotype.
2. Ventral view of anterior part of body.
3. Ceras.
4. Right jaw from inside and denticles of masticatory edge.
5. Median and lateral radular teeth.

Fig. 6-10. *Eubranchus rubeolus* sp. nov.
6. Dorsal view of living slug.
7. Ceras.
8. Right jaw from inside and denticles of masticatory edge.
9. Median and lateral radular teeth.
10. Penis.

Fig. 11-15. *Trinchesia sororum* sp. nov.
11. Dorsal view of living slug.
12. Ceras.
13. Right jaw from inside.
14. Radular tooth.
15. Penis and tip of stylet.

Fig. 16-21. *Toorna thelmae* sp. nov.
16. Dorsal view of living slug.
17. Rhinophore.
18. Penis.
19. Right jaw from inside.
20. Ceras.
21. Radular tooth.

R. Burn delin.

Abbreviations: *a*—anus; *b*—genital aperture; *c*—cnidosac; *d*—tentacles; *e*—digestive gland; *f*—median radular tooth; *g*—lateral radular tooth; *h*—rhinophores; *i*—denticles of masticatory borders; *j*—penis; *l*—male atrium; *m*—lateral marking of body; *n*—penial stylet.

THE IDENTITY OF THE VENOMOUS OCTOPUS RESPONSIBLE FOR A FATAL BITE AT DARWIN, NORTHERN TERRITORY

By DONALD F. McMICHAEL *

At Darwin, Northern Territory, in 1954, a young man was bitten by an octopus near the base of his neck, and died soon afterwards. The animal responsible for inflicting the bite was lost, but another specimen supposedly identical with the venomous animal was captured soon afterwards and forwarded to the South Australian Museum. Flecker and Cotton (1955) reported the death and identified the octopus as *Octopus rugosus* Bosc, at the same time publishing a photograph of the preserved animal. Lane (1957, p. 175) reported that Dr. Grace Pickford had informed him that the name was not valid and had been used indiscriminately for a variety of specimens belonging to other species.

In a recent publication (McMichael, 1964, in press) I speculated that the species concerned might have been a member of the genus *Hapalochlaena* Robson, since the *Hapalochlaena* species common in south-eastern Australia, *H. maculosa* (Hoyle), is known to inflict venomous bites. Through the kindness of Dr. Helene Laws, Curator of Invertebrates, South Australian Museum, Adelaide, I have been able to borrow the specimen sent from Darwin as identical with the venomous individual for study. The following notes concern its identification.

The octopus is small, with a pyriform body and head, the latter continuing straight into the web dorsally and laterally, but separated by a depression ventrally. The posterior end of the body is drawn out into a small point.

The following features were noted: Length of Mantle, 44 mm. Maximum width of Mantle, 32.5 mm. Width Index, 74%. Interocular width, 26.5 mm. Interocular Index, 60%. Total Body Length, 115 mm. Arm Formula, 4, 3, 2, 1. Pallial Aperture, Type B. Gill Filaments, 6-7 on each side. Funnel Organ, W shaped. Sex, female. No suckers markedly enlarged. Web very deep, measuring approximately 29 mm., with longest arms measuring 53 mm. Web depth approximately the same in each sector. Ink sac very small, embedded in posterior end of liver with only a small portion showing on the ventral surface of the liver.

The colour of the animal is, at first sight, a fairly uniform dark grey above and fades to light brown on the ventral surface. However, closer examination reveals that definite, numerous, iridescent blue circles, about 10 mm. diameter, are scattered over the dorsal surface of the body and web. The rings can be seen when the animal is viewed in oblique light, or when the skin is stretched a little. The animal compares closely with a specimen from Port Darwin, Northern Territory (AM. C.13867), which, though properly relaxed and of a light grey-brown colour with prominent blue rings, is similar in proportion and general shape to the specimen under review. Another specimen from Vanderlin Island, Gulf of Carpentaria, is also dark above, light brown below and shows clearly the iridescent blue circles (AM. C.51484).

Reference to Robson's Monograph (1929, pp. 207-214) shows that the specimen conforms with the characteristics of the genus *Hapalochlaena*, and the specimen seems to fit with the description of *H. lunulata* Quoy and Gaimard, which was described from New Ireland, and which ranges along the North-West coast of Australia and into the islands to the North.

* Curator of Molluscs, The Australian Museum, Sydney.

The genus *Hapalochlaena* Robson, as at present known, includes only the two species, *lunulata* Q. and G., and *maculata* Hoyle, both of which are now known to inflict venomous bites. I have previously shown that the posterior "salivary" glands of *H. maculosa* are very large compared with the size of the buccal mass (McMichael, 1964, in press) and it may well be that this enlargement is correlated with the production of a highly toxic venom, which can be regarded as a characteristic of the genus.

REFERENCES

FLECKER, H., and B. C. COTTON, 1955. Fatal Bite from Octopus. *Med. J. Aust.*, August 27, 1955, pp. 329-332, figs. 1, 2.

LANE, F. W., 1957. *Kingdom of the Octopus.* Chapter 11. Jarrolds, London.

McMICHAEL, D. F., 1964. (In press) Molluscs [in] *Active Venomous Animals and their Venoms.* Academic Press, N.Y.

ROBSON, G. C., 1929. *A Monograph of the Recent Cephalopoda.* Pt. 1. Octopodinae. British Museum (Nat. Hist.), London.

ASPECTS OF REPRODUCTION, SETTLING AND GROWTH IN THE MUSSEL *MYTILUS EDULIS PLANULATUS* LAMARCK

By B. WISELY, M.Sc. *

Text figs. 1-21.

SUMMARY

Mussels taken from Sydney Harbour between June 3 and August 18, 1960, spawned readily in the laboratory. Year-old females of shell length 40-59 mm. discharged an average of 1.85 million eggs. During early development the first micromere divided into two before the third micromere separated from the macromere. Records indicate the settling season in Sydney Harbour ranges from June to December with peaks about October and November. The mean length of year-old mussels taken from a raft in Sydney Harbour was substantially higher than that recorded for *Mytilus edulis edulis* Linné of comparable age.

INTRODUCTION

The biology of *Mytilus edulis planulatus* Lamarck in Sydney Harbour is not well known. Allen (1955) drew attention to the similarity in breeding temperature between this subspecies and *Mytilus edulis edulis* Linné. Wisely (1959) gave indications of the settling season of *planulatus* and more recently (1963) showed that the crawling larvae can detect an antifouling paint and show avoiding reactions to it. In the course of these investigations data have been collected on several other aspects of the biology of this organism which have not been reported on previously.

SPAWNING PERIOD

Observations made at the R.A.N. Station, Garden Island, in 1960, indicated that *planulatus* was in spawning condition suitable for artificial fertilization between June 3 and August 18. Gonad development increased during autumn (March-May) and by the beginning of winter (June) spawning seemed imminent. Accordingly, between June 3 and August 18, fourteen samples were taken from two rafts moored adjacently in the area. Each sample consisted of several hundred mussels of shell length 40-85 mm.; these were taken from just below (5 cm.) the waterline at the start of this sampling period, to deeper (30 cm.) at the end. These samples were transported in an insulated box without seawater to the laboratory and then immersed in a long shallow tank (2.3 x 0.2 x 0.7 m.) through which seawater flowed at a rate of about 360 l./hr.

Only two of these samples began spawning when placed in this tank, the July 13 sample began immediately and the August 3 sample commenced some four hours later. The rapidity of the July 13 spawning may have been associated with exceptionally heavy rainfall during the previous day. In the 24 hours preceding 9 a.m., July 13, 4.32 in. of rain fell in the general vicinity of Garden Island; this was practically equal to the average total rainfall for the month of July (4.45 in.). The resulting runoff discoloured surface water around Garden Island for several days and may have subjected the sample, which was taken only 5 cm. below the surface, to low salinities. The gonads of samples taken at the same depth seven days later were found to be spent. No unusual weather conditions were noted, however, during the few days preceding the taking of the August 3 sample. Samples taken from the same depth (30 cm.) on August 21, 26 and 29 were found to be spent and it was concluded that the spawning season had finished.

* Division of Fisheries and Oceanography, C.S.I.R.O., Cronulla, N.S.W.

The remaining 12 mussel samples collected between June 3 and August 18 did not spawn when they were placed in the running seawater tank; even though they were left there for several days, or in a few cases for a week. Spawning was induced in all these samples, however, by removing them in lots of about 50 and placing them in small tanks (0.3 x 0.3 x 0.5 m.) containing approximately 6 l. of stationary seawater. Usually several males commenced spawning within 30 minutes and this was followed by mass spawning of both sexes. The sperm and eggs obtained in all these samples were viable and young trochophores were subsequently obtained.

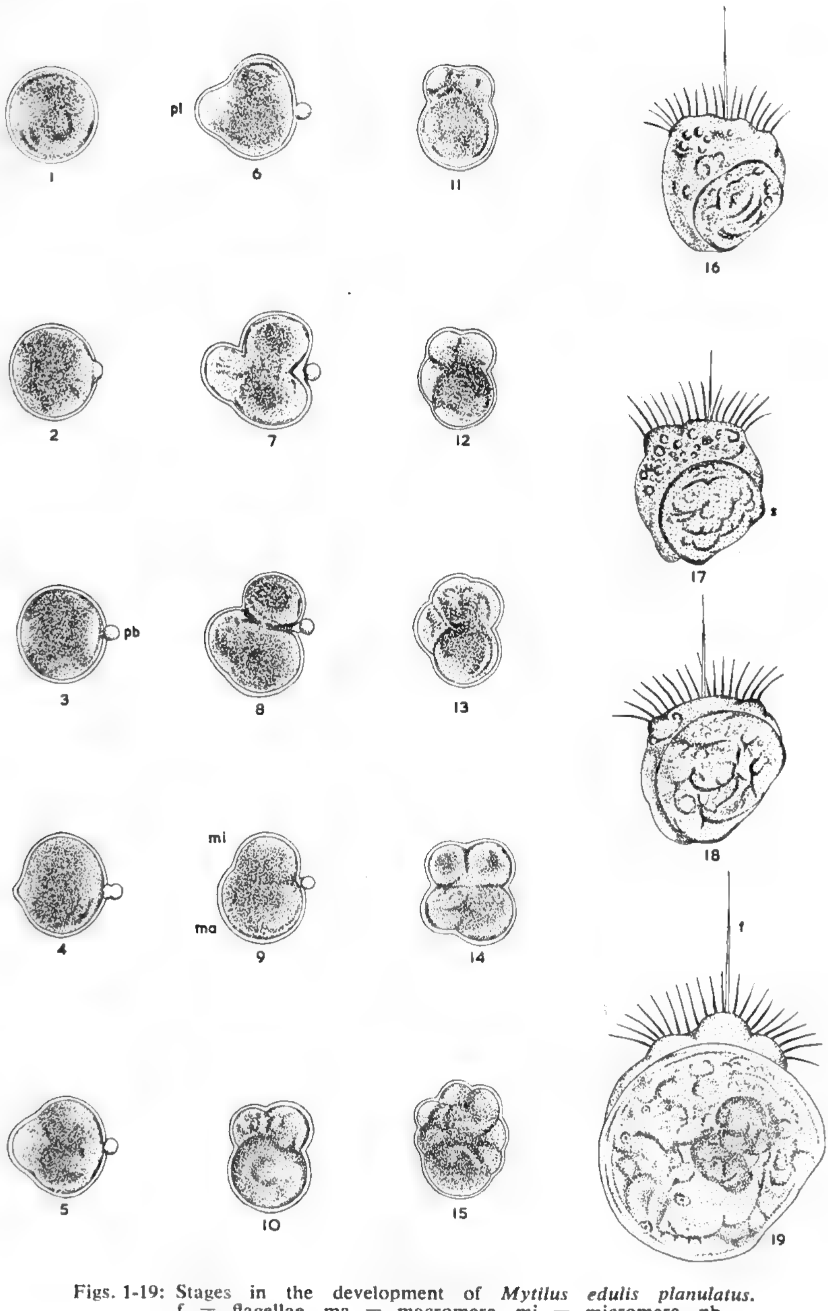
EGG NUMBERS

Females commencing spawning were removed immediately and placed singly in jars containing 1.5 l. of water. The latter was changed frequently to reduce the loss of eggs in suspension caused by their being sucked into the inhalent siphon and discharged as pseudofaeces. When spawning finished the mussels were opened and those not fully spent (8%) discarded. The shell lengths of the remainder were measured and the numbers of eggs released by them estimated. This was done by shaking the egg suspension until it appeared homogenous, withdrawing a 0.01 ml. sample and counting the eggs present in it. This procedure was repeated five times and the results averaged. The results obtained for 34 mussels of shell length 40-90 mm. are given in Table 1. The 27 mussels in the 40-59 mm. shell length range averaged 1.85 million eggs (range 0.96-5.08). These were taken from a raft which had been immersed only a year, indicating that the mussels had grown to maturity in that period. The eight mussels in the 60-90 mm. shell length range averaged 5.49 million eggs (2.35-10.00) but these mussels were taken from a raft immersed for several years.

EARLY DEVELOPMENT

The sperm head consists of an acrosome 2.5 μ long which is distinct from the large posterior part containing the nuclear material; the latter is globular with a truncate posterior end and measures 2 μ in length. The tail piece measures 42-46 μ in length. Before fertilization the egg is usually rounded or pear shaped with an irregular outline; after fertilization it becomes spherical and measures 63-66 μ in diameter (fig. 1). At 21°C. the first polar body appeared in most eggs 18-21 min. after sperm had been added (figs. 2, 3) and the second polar body about 20 min. later. No prominent external changes took place during the next 20-30 min. Then the vitelline membrane began to wrinkle on the side of the egg opposite the polar bodies. During the next 10 min. this region of the egg became less granular and the cytoplasm bulged out to form a large polar lobe (figs. 4-6). Transitory surface constrictions appeared giving the impression that the egg was becoming 3-celled but these disappeared as the polar lobe regressed into the lower part of the egg to form a large macromere (figs. 7-9). As this happened cleavage occurred in the plane of the polar bodies and separated off a micromere.

In *Mytilus edulis edulis,* Field (1922) considered the next stage was the formation of two more micromeres; the first of these was given off from the macromere and the second arose from the division of the original micromere almost at the same time. Observations on *planulatus* were made by adding fresh sperm to 2-cell eggs; the sperm, in attempting to fertilize the eggs, kept them rolling by the propulsive action of their tails. Individual eggs which were revolving slowly around an axis passing through the micromere and macromere were selected and observed. Division of the original micromere into two to give the 3-cell stage (fig. 10) was often observed. Figures 11-14 show the sequence of events drawn



Figs. 1-19: Stages in the development of *Mytilus edulis planulatus.* f = flagellae, ma = macromere, mi = micromere, pb = polar body, pl = polar lobe, s = shell (traced from photographs).

from successive photographs of the same egg. Figure 11 shows the 3-cell egg viewed from the side opposite the polar bodies. In figs. 12 and 13 the third micromere is shown developing from the macromere, and in fig. 14 the 4-cell stage consisting of three micromeres and the slightly larger macromere has been reached. Three-cell stages were most numerous about 60 min. after fertilization and there was a further lag of 20-30 min. before 4-cell stages became common. Divisions following the 4-cell stage and resulting in early blastulae (fig. 15) about 4 hours after fertilization were similar to those described by Field (1922) for *Mytilus edulis edulis*. Late gastrulae (20-24 hours after fertilization) were spherical or slightly oval and measured 63-66 μ in diameter.

In the young trochophore the posterior end became tapered and the cilia over the surface measured 10-20 μ in length. The cilia at the anterior end were longer and several flagellae measuring 50-55 μ in length appeared apically. The latter beat synchronously giving the impression they were one. During the next 24 hours shell glands appeared postero-dorsally and began to secrete the shell. The shell was at first a thin, flat, circular shape but subsequently divided along a line corresponding to the adult hinge line to form right and left valves. At this stage the stomodaeum, stomach and proctodaeum were already present and flagellates and other particles *c.* 2 μ in diameter were being ingested. Field (1922) figured a concave indentation at each end of the hinge line in comparable stage *edulis* but this indentation was not observed in *planulatus*. In the latter the edges of the valves curved around convexly from the end of the hinge line and maintained this shape during the next 1-2 weeks. The stages shown in figs. 16-19 were obtained in the laboratory by feeding the larvae with cultures of the small green flagellate *Nannochloris atomus* Butcher.

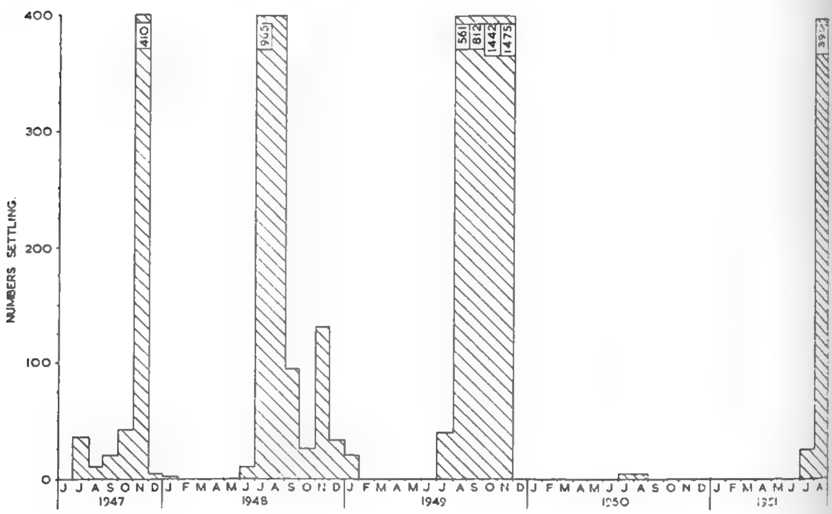


Fig. 20: Settling seasons of *Mytilus edulis planulatus* at the Spit Bridge, Sydney Harbour, 1947-51. Based on total counts of 4″ x 3″ ground glass plates immersed monthly. There was no count in August 1948 and the value for July was used.

SETTLING SEASONS

Settlement has been recorded on plates immersed at the Spit Bridge, North Head, Darling Harbour, Balmain and Garden Island (C.S.I.R.O., unpublished). These data substantiate Allen's (1955) suggestion that settlement commences in June or early July and terminates late in December. At the first three of these stations the average peak settlement months were October and November (Wisely, 1959). A series of monthly settling records obtained at the Spit Bridge between June, 1947, and August, 1951, is shown in fig. 20. In each year settlement commenced in June or July. The peak settling period varied from November (1947), July-August (1948) and October-November (1949). In June, 1950, abnormally heavy rainfall occurred at the Spit Bridge and may have been responsible for the abrupt termination of settling (Wisely, 1959).

GROWTH IN THE FIRST YEAR

One of the two rafts sampled at Garden Island was first immersed on June 30, 1959, and moored so that it was not in direct contact with wharves or the sea bed. The mussel population appearing on it during the following year most likely resulted from larval colonization. Two large samples of mussels were taken from the first raft on July 26, 1960; approximately one year after it had been immersed. The first sample of 664 was taken at a depth of 0-30 cm.; the shell length of these ranged from 12-59 mm. with a peak concentration at 35 mm. (fig. 21). The second sample of 340 was taken at a greater depth (46-122 cm.) and ranged from 24-66 mm. shell length with a peak at 49 mm. The mussels in the upper sample were clearly smaller and showed greater variability in length than those in the lower sample. The upper sample had a mean length of 35.3 $\pm$ 8.8 mm. (standard deviation) and the lower 48.9 $\pm$ 6.9 mm.

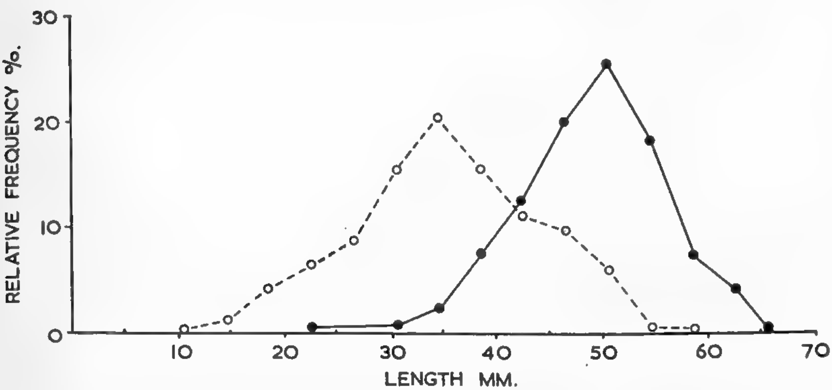


Fig. 21: Length frequency distributions of *Mytilus edulis planulatus* taken from a raft at the R.A.N. Station, Garden Island, after a year's immersion. The upper sample (– – – – –) was taken from a depth of 0-30 cm.; the lower sample (————) from 46-122 cm. (4 mm. classes).

There are several points of interest in these samples. Firstly, it was shown earlier that mussels from 40-59 mm. shell length were capable of producing an average of 1.85 million eggs. Evidently about a quarter of the upper sample and most of the lower sample were capable of attaining this in their first year's growth (fig. 21). Secondly, growth was more rapid in the lower sample. Thirdly, the mean growth of both samples was in excess of Field's (1922) estimate for *Mytilus edulis edulis*. In

summing up data from various sources Field considered that *edulis* could increase in length about 25 mm. annually for the first two or three years, providing it was in ideal conditions. Under the conditions found in many natural mussel beds however, growth was less and amounted to a total of about 76 mm. in 5-7 years. The means of both the Garden Island samples (35 and 49 mm.) were significantly higher than the 25 mm. annual increment for *edulis* under "ideal" conditions. However, it is pointed out that the Garden Island samples were from rafts, where the growing conditions were possibly more favourable than the sea beds where *edulis* normally occurs.

ACKNOWLEDGMENTS

The above forms part of a programme on the biology of fouling organisms carried out in co-operation with the Royal Australian Navy. The author thanks Mr. A. E. Stark of the C.S.I.R.O., Division of Mathematical Statistics, for analysing the sampling results.

REFERENCES

ALLEN, F. E., 1955. Identity of breeding temperatures in Southern and Northern Hemisphere species of *Mytilus* (Lamellibranchia). *Pacif. Sci.* 9: 107-109.

FIELD, I. A., 1922. Biology and economic value of the sea mussel *Mytilus edulis*. *Bull. U.S. Bur. Fish.* 38.

WISELY, B., 1959. Factors influencing the settlement of the principal marine fouling organisms in Sydney Harbour. *Aust. J. Mar. Freshw. Res.* 10: 30-44.

WISELY, B., 1963. Detection and avoidance of a cuprous oxide anti-fouling paint by bivalve and gastropod larvae (Mollusca). *Aust. J. Mar. Freshw. Res.* 14: 60-69.

TABLE 1

NUMBER OF EGGS SPAWNED BY *MYTILUS EDULIS PLANULATUS* UNDER LABORATORY CONDITIONS

Mussel No.	Mussel Length (mm.)	Millions of Eggs	Mussel No.	Mussel Length (mm.)	Millions of Eggs	Mussel No.	Mussel Length (mm.)	Millions of Eggs
1	40	0.96	13	48	1.24	25	55	2.15
2	41	2.37	14	48	0.97	26	59	1.72
3	43	2.53	15	49	5.08	27	60	3.52
4	44	1.00	16	50	2.41	28	61	3.40
5	44	1.27	17	50	1.52	29	62	2.30
6	45	1.07	18	50	2.64	30	64	5.04
7	45	1.53	19	50	1.44	31	79	6.50
8	46	1.38	20	51	1.38	32	84	7.53
9	46	2.90	21	51	2.10	33	85	10.00
10	46	2.70	22	52	1.28	34	90	5.68
11	47	1.20	23	53	1.22			
12	47	1.86	24	54	2.31			

A NEW MUREX FROM THE GREAT AUSTRALIAN BIGHT (GASTROPODA: MURICIDAE)

By DONALD F. McMICHAEL *

Pl. 4.

The species to be described was collected by the F.I.S. "Endeavour" on the 2nd April, 1913. Two dead shells were obtained and for some reason they were not mentioned by either of the workers who reported on the "Endeavour" shells (Verco, 1912, and Hedley, 1911, 1914). The shells were discovered in the Australian Museum some time ago when transferring the "Endeavour" collections and they attracted interest at once because of their large size and obvious difference from any known South Australian species.

Study of collections (both at the Australian Museum and the British Museum (Natural History)) failed to reveal any similar specimens and no descriptions or illustrations in literature have been found which can be identified with the "Endeavour" shells. Thus they are regarded as representing a new species, which is described below.

The species most resembles members of the genus *Murexsul* Iredale, which some workers regard as a subgenus of the widespread *Hexaplex* Perry. It is nearest *Murexsul octogonus* (Quoy and Gaimard) from New Zealand, but differs in having fewer varices per whorl, more rounded whorls, relatively greater width, and in its generally larger size. The living South Australian *Murexsul* species (*umbilicatus* (Tenison Woods), *fimbriatus* (Lamarck) and *brazieri* (Angas)) are all much smaller, growing to less than half the length of the new species. No fossil species which can be related to the new species are known, other than *Murexsul suboctogonus* (Ludbrook) which differs, however, in the same way as does *M. octogonus*. Some species of *Hexaplex* s.l. from West Africa (such as *H. varius* Sowerby) are rather similar to the South Australian species and it is also not unlike large specimens of *Basiella stainforthi* (Reeve), from north Western Australia. The latter is quite brightly coloured with a pink aperture and dark varices, while the new species is unicolour brown. *B. stainforthi* also has more numerous varices and a shorter spire.

Murexsul conatus sp. nov.

Description: Shell large for the genus, maximum length 54.5 mm., maximum width (including spines at aperture) 33 mm. Spire elevated, slightly less than half the total length, anterior canal of moderate length, projecting about 13 mm. beyond bottom of aperture. Protoconch pupiform, of three loosely coiled, smooth, rounded whorls. Adult whorls five and a half, discrepant, sculptured with several strong, spiral ridges crossing prominent axial ribs of which there are thirteen on the first post-nuclear whorl. Subsequent whorls with decreasing numbers of ribs, which become differentiated into primary ribs with spines (varices) and secondary ribs without spines situated between the varices. Body whorl with seven varices, and with six secondary ribs, the former continuous from shoulder to anterior canal, the latter short and extending only across the periphery of the whorl. Varices foliated, bearing short, hollow, open spines, the largest at the shoulder whorl (about six mm. long) and three additional large spines at the base, just above the flattened columellar extension bordering the anterior canal. Spiral sculpture well developed on body whorl, with about fifteen unequal granulose ribs, between each of which there are three to five secondary riblets. Aperture rounded, crenulate at the outer margin as a result of the foliations on the outer lip; columellar

* Curator of Molluscs, The Australian Museum, Sydney.

lip well developed as a strong white callus, slightly elevated from the base of the body whorl. Colour white, covered externally with a well developed, creamish brown periostracum.

Animal unknown.

Types and Type Locality: The holotype and one paratype are in the Australian Museum, Registered Number C.35592. They were collected between longitudes 126° E. and 129° E. in approximately 100 fathoms, Great Australian Bight, 2nd April, 1913. The position of "Endeavour" on this date was approximately South-West of Eucla, Western Australia.

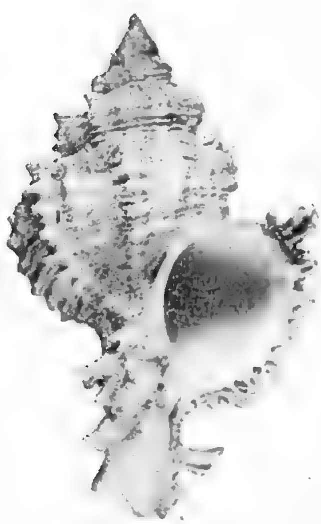
Remarks: Comparison of the three species, *octogonus, conatus,* and *stainforthi,* show an intergradation of characters suggesting that the genera *Murexsul* and *Bassiella* Wenz might well be merged. However, pending a comprehensive revision of the whole generic classification of the Muricidae, the groups are here maintained as distinct genera. The specific name derives from the Latin verb *conatus,* to endeavour, in honour of the many discoveries made by the "Endeavour" during her brief working life.

REFERENCES

HEDLEY, C., 1911. Report on the Mollusca obtained by the F.I.S. "Endeavour" chiefly off Cape Wiles, South Australia. Part 1. *Zool. Res. Fish. Exp. "Endeavour"*, 1: 89-114, pls. 17-20.

HEDLEY, C., 1914. Mollusca from the Great Australian Bight. *Zool. Res. Fish. Exp. "Endeavour"*, 2: 63-74, pls. 8-12.

VERCO, J. C., 1912. Shells from the Great Australian Bight. *Trans. Roy. Soc. S. Aust.*, 36: 206-232, pls. 10-14, 16.



Pl. 4. *Murexsul conatus* sp. nov. Holotype. AM. C.35592. 100 fms., Great Australian Bight, South Australia. Approx. nat. size.

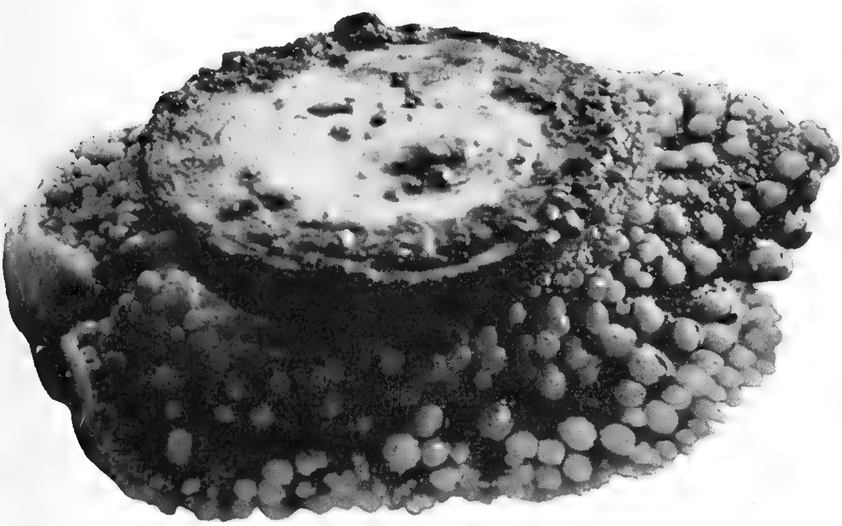
EGG LAYING AND EARLY DEVELOPMENT OF *UMBRACULUM SINICUM* GMELIN

By THELMA W. HARTLEY *

Pls. 5-7.

On January 29th, 1964, while collecting on an extremely low tide at Dunwich, North Stradbroke Island, Queensland, I found a specimen of *Umbraculum sinicum* Gmelin. It was a magnificent creature of bright orange colour, covered with soft, rounded, white pustules, apparently filled with a fluid substance. They stood out most vividly against the background colour of the animal.

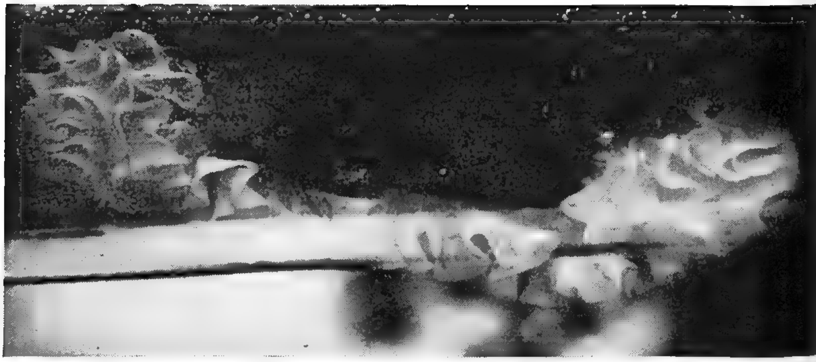
The animal measured nine inches in length and stood a little over four inches in height when found. The oval shell was three and a half inches long and three inches wide. The *Umbraculum* was found on a small mound of dry sand on One Mile Beach at Dunwich, although I understand they normally burrow into the mud and are often found in pairs. The sandy mud is bordered by spongy coral reef at One Mile Beach.



Pl. 5: *Umbraculum sinicum* Gmelin, living specimen.

The animal moved slowly over the sand displaying an undulating motion around the outer edge of the foot. Occasionally the shell was raised about an inch when the black eyes on pinkish stalks were protruded. The eyes are not quite terminal, but are set back a fraction of an inch from the end of the eye stalk, the part distal to the eye being capable of some protrusion. The gill is on the right-side and the shell is consequently larger on the right side, which makes the "knob" or apical

* 351 Glenferrie Road, Malvern, S.E.4, Victoria.



Pl. 6: Egg ribbon of *Umbraculum* photographed through about four inches of water.

papilla on the dorsal surface of the shell eccentric. The gill is completely concealed when the shell is pulled down close against the body, and is set in a 'scooped' out oval depression immediately below the shell, the shape of the depression following the outline of the shell.

This was, without a doubt, the most impressive and extraordinary creature I had ever had the good fortune to collect. I took it immediately to the University of Queensland's Marine Laboratory at Dunwich and placed it in an aerated tank until I could take it back to Brisbane with me.

On February 2nd, four days after the animal was placed in the tank on Dunwich, it was transferred to a container of sea water, preparatory to the ferry trip to Brisbane. I thought at this time the animal seemed 'smaller', and when returned to an aquarium in Brisbane, it definitely was much smaller in size. The shrinkage may have been due to the more concentrated tank environment drawing water from the animal.

During the night, following its return to an aquarium in Brisbane, the *Umbraculum* crawled to the very top of the side of the aquarium and there laid a pinkish lavender egg ribbon. It was heavily pleated with half inch wide folds spaced about eight folds to the inch, making its free border about four feet long. The attached border was about one foot in length. The free border was without egg-capsules in the outermost two millimetres. The egg-capsules were imbedded in a transparent, gelatinous and tough mucus. The ribbon measured $\frac{3}{4}$ inch in width, $\frac{1}{16}$ inch in thickness, with about one hundred and twenty egg-capsules per half inch. Each capsule contained a dozen embryos, making a total of approximately one hundred thousand in the egg ribbon.

The animal took over four hours to place this exquisite fluted ribbon on the side of the tank. The next evening the animal crept along until it located the end of the ribbon where it stayed some hours then went back behind the rocks in the aquarium without adding to the length of the ribbon.

Pl. 7: Two photographs of the embryos of *Umbraculum*. Magnification approx. X300.

The embryos, when examined three weeks later, were still unhatched, but upon close examination from the side the embryos appeared to be shaped like a miniature *Nautilus* shell and, on looking into the 'opening', they appeared to be a spiral shell with an aperture and not just a flat plate. The colour of the ribbon had changed to dark brown as the embryos developed.

Unfortunately the animal died after being in the tank for two weeks. The eggs blackened after three weeks and disappeared completely from the tank's side.

The *Umbraculum* shell possesses growth lines externally, but internally it possesses a circular muscle scar, a glorious shade of burnt sienna which is enclosed in a larger circle or halo of brown.

MONOGRAPHS OF THE GENERA *MEGALACRON* AND *RHYTIDOCONCHA* (PAPUININAE: CAMAENIDAE)

By WILLIAM J. CLENCH * and RUTH D. TURNER *

Pls. 8-11, Text figs. 1-9.

SUMMARY

This present study is a companion report to the one published in this Journal, No. 6, January, 1963, which covered the genera *Papustyla, Forcartia* and *Meliobba.* The two genera, *Megalacron* and *Rhytidoconcha,* reviewed in this report occur in the Bismarck Archipelago with two species, *M. boyeri* F. & B., found only on Woodlark Id., off the north-east coast of New Guinea, and *M. alfredi* Cox from Buka and Bougainville Islands in the northern Solomon Islands.

ACKNOWLEDGMENTS

We are deeply indebted to many individuals and institutions for the generous use of their collections. Their kindness has made this study possible.

Abbott, R. T., Academy of Natural Sciences, Philadelphia, Pennsylvania.

Dance, S. P., British Museum (Nat. Hist.), London, England.

Dell, R. K., Dominion Museum, Wellington, New Zealand.

Emerson, W. K., American Museum of Natural History, New York, New York.

Haas, Fritz, Chicago Natural History Museum, Chicago, Illinois.

McMichael, D. F., Australian Museum, Sydney, N.S.W., Australia.

Rehder, H. A., United States National Museum, Washington, D.C.

Rensch, Bernard, Zool. Inst. der Universität, Münster, West Germany.

Van der Schalie, H., University of Michigan, Ann Arbor, Michigan.

Wolff, Torben, Univ. Museum, Kobenhavn, Denmark.

We are most grateful to Peter Dance, Lothar Forcart, Rudolph Kilias, D. F. McMichael and Adolph Zilch for photographs of the type specimens in their charge.

ABBREVIATIONS

AM — Australian Museum, Sydney.
AMNH — American Museum of Natural History, New York.
BM — Berlin Museum, Berlin, Germany.
BMNH — British Museum (Natural History), London.
BPBM — B. P. Bishop Museum, Honolulu, Hawaii.
CM — Chicago Natural History Museum, Chicago, Illinois.
DM — Dominion Museum, Wellington, New Zealand.
MCZ — Museum of Comparative Zoology, Cambridge, Massachusetts.
MM — Manchester Museum, Manchester, England.
SMF — Senckenberg Museum, Frankfurt am Main, Germany.
UM — Museum of Zoology, Univ. of Michigan, Ann Arbor, Michigan.
UMK — Univ. Museum, Kobenhavn., Denmark.
USNM — United States National Museum. Washington, D.C.

* Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.

Genus *MEGALACRON* I. Rensch.

Pileolus Lesson, 1830, *Voyage Autour du Monde . . . la Coquille, Zoologie*, 2:313; non *Pileolus* Sowerby, 1823; Ehrenberg, 1843; Spriesterbach, 1919. [Two species are described, *tuffetii* and *gaberti*, the former is here selected as the type species.]

Megalacron I. Rensch, 1934, *Archiv. für Naturgeschichte, N.F.*, 3:487 (type species, *Helix novaegeorgiensis* Cox, original designation).

Emiralena Iredale, 1941, *Australian Zoologist*, 10:84 (type species, *Helix moseleyi* Smith, original designation).

Lisprelia Iredale, 1941, *Australian Zoologist*, 10:85 (type species, *Helix novaegeorgiensis* Cox, original designation).

Pinnadena Iredale, 1941, *Australian Zoologist*, 10:84 (type species, *Helix lombei* Pfr. [sic.], original designation).

The genus *Megalacron* is limited mainly to the Bismarck Archipelago with two outliers, *M. boyeri* F. & B. occurring only on Woodlark Island, off the north-eastern tip of New Guinea, and *M. alfredi* Cox from Buka and Bougainville Islands in the northern Solomons.

There are three rather well defined species groups in this genus. The species group of *M. lambei* Pfr. occurs in the easterly portion of the Bismarcks, from Mussau on the north, south through New Ireland, eastern New Britain and Buka-Bougainville Islands in the northern Solomon group of islands, and in Woodlark Island, off the south-east coast of New Guinea.

The species group of *M. phaeostoma* v. Martens occurs on Manus Island, Admiralty Islands, then jumps to New Hanover, New Ireland and Nisson.

The species group of *M. novaegeorgiensis* Cox occurs only on Manus Island and its associated islands, Admiralty Islands, and two outliers, in the Ninigo Group and on the French or Vitu Islands, between the Admiralty Islands and New Britain.

The genus *Megalacron* is composed of species with imperforate shells which range from lenticular to moderately attenuate in shape. The whorls of some species may be strongly convex and rounded, while in others the whorls may be flat sided and sharply keeled. The papuinoid notch on the outer lip is absent or only faintly indicated. Colour patterns are of spiral bands and zigzag markings of brownish to blackish brown. Yellow is present in some specimens of *M. klaarwateri* Rensch. The sculpture is quite similar in all species other than *M. alfredi* Cox, which is smooth. This sculpture consists of irregular, interlacing, incised lines which separate small areas from one another. Above the whorl periphery these are arranged in a diagonal pattern, while below the periphery they are in spiral arrangement.

ANATOMICAL NOTES

In our earlier paper we reiterated the statement of Pilsbry that a study of the variation in the genitalia and radulae of the many species complexes should prove fruitful and contribute greatly to an understanding of the phylogeny and paths of dispersal of the Papuininae, and this is certainly proving to be the case. In this study we are considering 18 species, 16 in the genus *Megalacron* and 2 in *Rhytidoconcha*. Species such as *tabarensis* and *lambei*, which are found on several islands, have

produced clearly defined subspecies, bringing the total number of forms considered to 27. Of the 18 species the soft parts of only 9 were available for study, but fortunately these were well distributed throughout the species complexes of *Megalacron* as established on the basis of the shells. The following were studied: *tabarensis, lihirensis* and *spadicea danckeri* in the "*lambei* group"; *phaeostoma, admiralitatis* and *melanesia* in the "*phaeostoma* group"; *novaegeorgiensis, klaarwateri* and *lufensis* in the "*novaegeorgiensis* group" and *confirmata* in the genus *Rhytidoconcha.*

Rensch figured the reproductive system of *Megalacron lambei vuatomensis* Rensch (1934, p. 449) and that of *Rhytidoconcha inquierenda* Rensch (1933, p. 314). Both agree with the closely related species which we have studied.

All species studied in the genus *Megalacron* are similar to *Papustyla* in having a long spermathecal duct, in having a small inconspicuous epiphallus, in lacking a flagellum and having the jaws ribbed. Most species in *Megalacron* have the denticles on the radula arranged in V-shaped rows as in *Papustyla,* the denticles of one transverse row offset from those of the next, but in *klaarwateri, novaegeorgiensis* and *lufensis* they are in nearly straight rows, the transverse rows of denticles lining up with each other. Species in *Papustyla,* at least as seen in *hindei,* produce a few rather large eggs with calcareous shells, there being 16 in the specimen studied. In *Megalacron* both *klaarwateri* and *novaegeorgiensis* are ovoviviparous, producing only two large young at a time. Unfortunately in no other species were the dissected specimens carrying young or eggs. Additional material is needed for study in order to fill in the many gaps in our knowledge of the life histories of the Papuininae.

All specimens dissected were preserved, some of them for many years; therefore, notes on the coloration of the animal are tentative. The amount of shrinkage which has occurred is impossible to estimate, and there is no way of knowing the age or the phase of the breeding cycle most of the specimens were in, though all had shells with fully developed lips and were therefore considered adults. Consequently no significance is given to minor differences in proportions. Brief notes are given with each species dissected, pointing out major characteristics. The various organs have been separated somewhat for purposes of illustration. The spermatheca and its duct are normally closely attached to the uterus and prostate gland, and the vas deferens passes down the side of the oviduct and vagina, through the penio-oviducal angle and up the side of the penis to which it is closely attached.

As with our previous paper, only the anatomy of the reproductive system is illustrated here, as it is this system which is most useful in classification. It is hoped, however, that with the completion of these studies sufficient preserved material will be available so that a survey of the anatomy of the subfamily Papuininae will be possible.

Species Group of *Megalacron lambei* Pfeiffer.

The several species contained in this group are characterized by having depressed and strongly convex whorls, the whorl periphery being round or sharply keeled. Shell usually with spiral bands, with or without zigzag marks between the bands.

Distribution: Occurring in the easterly Bismarcks from Mussau south through New Ireland, eastern New Britain, Buka and Bougainville in the northern Solomons and Woodlark Island, off the north-eastern tip of New Guinea.

Megalacron coniformis (Férussac).

Plate 9, fig. 9.

Helix (Helicostyla) coniformis Férussac, 1821, *Tableaux Systématiques des Animaux Mollusques*, p. 47, pl. 108, fig. 1 (locality unknown [Port Praslin, New Ireland]). [Type probably in the Paris Museum.]

Helix (Pileolus) tuffetii Lesson, 1830, *Voyage Autour du Monde de la Coquille, Zoologie*, 2:313, pl. 10, fig. 3 (Port Praslin, New Ireland [Bismarck Archipelago]).

Helix turbinata Deshayes, 1831, *Encyclopédie Méthodique, vers.* 2:265 (New Zealand).

Helix coniformis Quoy and Gaimard, 1832 [in] Dumont d'Urville, *Voyage de l'Astrolabe*, 2:105, pl. 8, fig. 15-17 (Carteret Harbor, New Ireland).

Helix coniformis Férussac. Férussac and Deshayes, 1850, *Hist. Nat. Gén. et Part. des Mollusques*, 1:322, pl. 108, fig. 1 (Port Pralin [Praslin], New Ireland).

Helix touffetii 'Lesson' Férussac and Deshayes, 1850, *Hist. Nat. Gén. et Part. des Mollusques*, 1:322 [error for *tuffetii* Lesson].

Description: Shell trochiform, reaching about 23.5 mm. in greater diameter, nearly smooth, very finely sculptured and imperforate. Whorls 5, strongly convex. Spire elevated and cast at an angle of about 75°. Color consisting of 2 spiral bands of reddish brown, one above and one below the periphery. Peripheral area white; remainder of shell, between the suture and the spiral band, a pale ivory, marbled with irregular reddish brown markings. Lip white, rather broad, reflected and cast at an angle of about 25° from the base. Sculpture consisting of minute and irregular incised lines which cross the growth lines at a right angle.

Height	Width	
21 mm.	20 mm.	Férussac and Deshayes (figure).
23 mm.	22 mm.	New Ireland.
22.2 mm.	23.5 mm.	,,
20 mm.	23.2 mm.	,,

Remarks: We have seen but three specimens of this species contained in the collections of the University of Michigan and the British Museum. In the specimens studied there are a few small and irregular patches of brown in the ivory area above the supraperipheral band. Both Férussac and Quoy and Gaimard described this species under the same name. The figures are somewhat different, but the descriptions would indicate that only one species was involved. The two type localities, Carteret Harbor and Port Praslin, are only about ten miles apart. It is quite possible that *tuffetii* is a dark phase of this species.

Specimens examined: New Ireland: (UM; BMNH).

Megalacron lambei (Pfeiffer).

Plate 8, fig. 1.

Helix lambei Pfeiffer, 1856, *Malakozoologische Blätter*, 3:239 (Admiralty Islands). [Lectotype, British Mus.; paratypes, Mus. Comp. Zool., no. 72049.]

Helix lombei Pfeiffer, 1856 [1857], *Proc. Zool. Soc. London*, p. 382, pl. 36, fig. 6-7 [error for *lambei* Pfeiffer].

Description: Shell subdepressed, conic, light in structure but strong, reaching 20 mm. in height, imperforate and smooth. Whorls 5 and strongly convex. From the second and to the body whorl there are two bands above and below the periphery which overlay in part a series of

irregular subaxial bars of brown. There is considerable variation in the amount of coloration even among specimens obtained from one locality. Spire depressed and produced at an angle of 95°. Aperture subcircular and slightly descending. Parietal lip consisting of a very thin glaze, palatal lip white, somewhat thickened, reflected and produced at an angle or 55° from the base. Columella white flattened and strongly arched. Suture well defined and slightly indented. Sculpture consisting of numerous and fine growth lines. The fine sculpture consists of oblique, irregular depressions and ridges. Protoconch consisting of 1½ smooth whorls.

Height	Width	
19 mm.	29 mm.	Paratype of *lambei* Pfr.
20.5 mm.	29.5 mm.	Duke of York Island, Bismarck Archipelago.

Remarks: The type locality, "Admiralty Islands", is certainly in error and also the locality, Solomon Islands, which has been frequently listed for this species. So far as now known, it occurs on Duke of York Island (Neu Lauenburg), off the Gazelle Peninsula of New Britain, New Britain and New Ireland, Bismarck Archipelago. Rensch has reported it from New Ireland without further data, but we have not seen his specimens.

Specimens examined: Duke of York Id.: (MCZ; BMNH). New Ireland: (MCZ). New Britain: Mope (MCZ).

Megalacron lambei vuatomensis (Rensch).

Plate 8, fig. 4; Plate 11, fig. 10-12.

Papuina lambei vuatomensis Rensch, 1934, *Archiv für Naturgeschichte, Leipzig, N.F.* 3:450, text fig. 1 (anatomy), (Vuatom Island, Neu Pommern Island [New Britain], Bismarck Archipelago). Holotype, Berlin Mus.; paratypes, Basel Mus. and Acad. Nat. Sci. Phila.

Description: Shell depressed, rather thin and reaching 23 mm. in greater diameter. Color light ivory white with two rather narrow bands of dark mahogany brown near and above and below the periphery. These bands are somewhat irregular with the color somewhat diffused. Whorls 4¼, convex and rather bluntly keeled at the periphery. Spire depressed, may be straight sided and produced at an angle of 105°. Aperture subovate and cast at an angle of 45° from the base. Parietal wall thinly glazed. Palatal lip reflected and slightly thickened. Columella short, arched to the right and moderately keeled on its inner edge. Umbilical depression rather deep. Suture clearly marked but not impressed. Sculpture consisting of numerous and fine growth lines which are crossed by fine and very irregular depressions.

Height	Width	
15.5 mm.	23 mm.	Paratype.

Remarks: This subspecies differs from the typical form by a reduction in the color pattern, with only the two peripheral bands of brown remaining. It is known only from the small island of Vuatom (Watom or Mau Id.), which is just off the north coast of the Gazelle Peninsula of New Britain Island.

Specimens examined: New Britain: Vuatom Id. (Basel Mus.; ANSP).

Megalacron lambei novohibernica (M. Smith).

Plate 9, fig. 1.

Papuina lambei novohibernica M. Smith, 1946, *Nautilus,* 59:94, pl. 9, fig. A ([Kavieng] New Ireland [Bismarck Archipelago]). [Holotype, Florida State Museum, Gainesville; paratypes Mus. Comp. Zool. no. 157309; 157310.]

Description: Shell depressed-turbinate, imperforate and rather strong. Whorls 4½ to 5, strongly convex and with a prominent keel at the whorl periphery. Color consisting of two solid bands of dark mahogany brown, one above and the other below the whorl periphery. Mottled color pattern consisting of strong subaxial, sigmoid, brown bars more or less in axial arrangement on a straw yellow to ivory background.

Height	Width	
16 mm.	26.5 mm.	Holotype.
16 mm.	24.5 mm.	Paratype.
16.5 mm.	27 mm.	"

Remarks: This subspecies differs from typical *lambei* by being more sharply keeled, having the whorls less globose and having a small basal tooth on the columella. The color pattern is similar, differing only in having the color bands produced almost centrally above and below the periphery, while in *lambei* they are both very close to the periphery. Thus on the early whorls the supraperipheral band appears centrally placed in *novohibernica* and sutural in *lambei*.

Specimens examined: New Ireland: Kavieng, North Cape (Florida State Mus.; MCZ).

Megalacron tabarensis (Rensch).

Plate 9, fig. 2.

Papuina tabarensis Rensch, 1933, *Zool. Anzeiger*, 102:316, fig. 4 (Tabar Island, Bismarck Archipelago). [Holotype, Basel Mus., Switzerland; paratypes, Berlin Mus. and Mus. Comp. Zool. no. 59848.]

Description: Shell depressed-turbinate, generally keeled, imperforate and minutely sculptured. Base color a light ivory with a varying pattern of dark reddish brown. A typical specimen has two spiral bands of brown, one above and one a little below the periphery. From the upper band to the suture and from the lower band to the umbilical area there are numerous, very irregular zigzag bars of this same coloration. The peripheral area between the bands is ivory. A few specimens lack the bands but have the zigzag bars and rarely a specimen has only the spiral bands. A very few specimens are nearly entirely ivory but show the pattern when viewed in transmitted light by the opaque and translucent areas of the shell. Some specimens show a fusion of the bands and the zigzag bars giving the shell a nearly uniform brown color. In transmitted light the brownish areas are translucent and the ivory areas opaque. Whorls 4½ and moderately convex. Spire depressed. Aperture subcircular with the outer lip reflected and generally white, occasionally stained with brown opposite the spiral bands. Parietal lip consisting of a very thin glaze. Columella strongly arched and somewhat angled where it meets the base of the lip. Sutures moderately indented. Sculpture consisting of numerous and very fine diagonal incised lines above the whorl periphery. Below the periphery this same type of sculpture is spiral.

Height	Width	
17 mm.	27 mm.	Tabar Island, Bismarck Archipelago.
16.5 mm.	24.5 mm.	" "
14.5 mm.	23 mm.	" "

Remarks: This species is allied to *M. novohibernica* (M. Smith). It differs by being more elevated, being lighter in structure and having a more open pattern in its coloration.

M. tabarensis heads the assemblage of subspecies that occupy the line of islands that lie about 25 to 40 miles off the east coast of New Ireland in the Bismarck Archipelago.

Specimens examined: New Ireland: Tabar Id. (AMNH; MCZ).

Megalacron tabarensis lihirensis (Rensch).

Plate 11, fig. 1-3; text figure 1.

Papuina lambei lihirensis Rensch, 1934, *Archiv für Naturgeschichte N.F.*, 3:450 (Lihir Island, Lihir Group, Bismarck Archipelago). [Holotype, Berlin Mus.; paratype, Acad. Nat. Sci. Philadelphia no. 167801.]

Description: This subspecies is close to the typical form but does differ by being slightly larger, more acutely keeled and in having a modification of the color pattern. The chevron-shaped pattern of the typical form in this subspecies differs by becoming nearly spiral, particularly so on the base.

Height	Width	
19 mm.	29.5 mm.	Malie Id., Lihir Group.
17 mm.	27.5 mm.	,, ,,
16 mm.	27 mm.	,, ,,

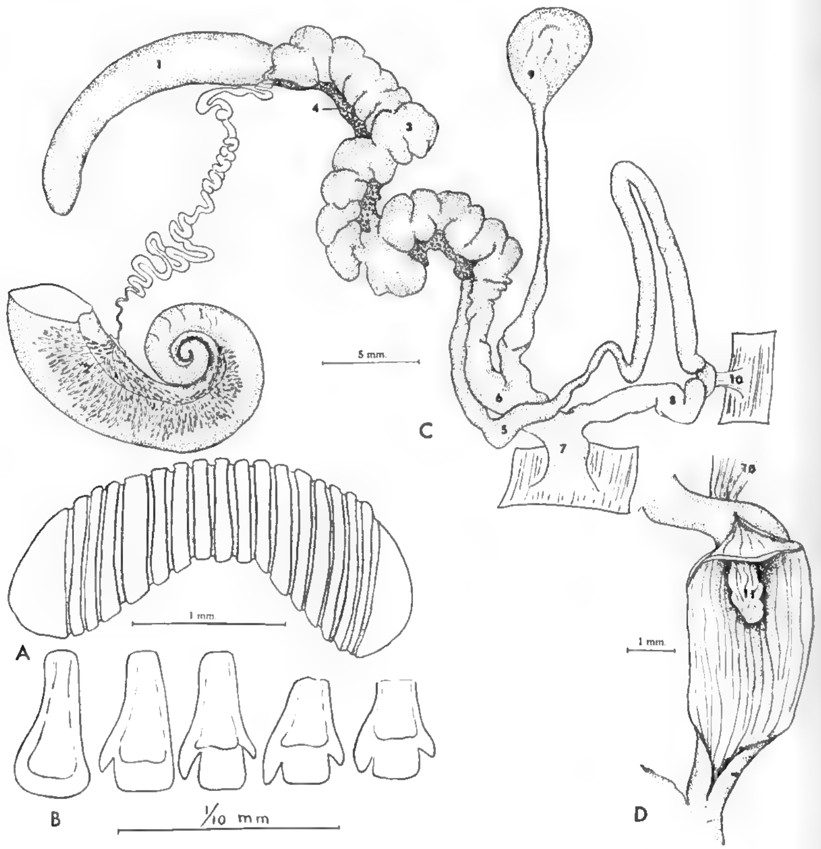


Fig. 1.

Megalacron tabarensis lihirensis (Rensch). A, jaw. B, radular teeth. C, complete reproductive system. D, dissected penis.
Labelling for reproductive system:—1, albumen gland. 2, ovotestis. 3, uterus. 4, prostate gland. 5, vas deferens. 6, vagina. 7, atrium. 8, penis. 9, spermatheca. 10, penial retractor muscle. 11, penis papilla. 12, young in the uterus.

Remarks: Animal a uniform light tan. The jaws, denticles of the radula and the reproductive system are shown in text figure 1(a-d). The jaws are strongly ribbed (a) and the denticles of the radula are arranged in staggered V-shaped rows. The penis was thin walled, lacking pilasters and the penis papilla large.

Specimens examined: NEW IRELAND: Malie Id., Mashet Id. (both AMNH; MCZ).

Megalacron tabarensis mahurensis (Rensch).

Plate 8, fig. 5-6.

Papuina lambei mahurensis Rensch, 1934, *Archiv für Naturgeschichte N.F.*, 3:451 (Mahur Island, Lihir Group, Bismarck Archipelago). [Holotype, Senckenberg Mus. no. 7578.]

Description: This subspecies is close in its relationship to the typical species, differing mainly in its more convex whorls and by the color pattern. In *mahurensis* the zigzag bars are almost entirely lacking on the basal area and when present above the periphery they are usually reduced to a series of brownish dots margining the suture. The lower of the two peripheral bands is always wider. The one above the periphery and the upper band on many specimens may be lacking entirely.

Height	Width	
18.5 mm.	27 mm.	Mahur Id., Lihir Group, Bismarck Archipelago.
16.5 mm.	22.5 mm.	,, ,, ,,
16 mm.	25 mm.	,, ,, ,,

Remarks: This subspecies differs from both *tabarensis* and *lihirensis* by being somewhat smaller, proportionately higher and having the color marking more irregular, and in many specimens limited to only a series of dots along the suture.

Specimens examined: NEW IRELAND: Mahur Island, Lihir Group (AMNH; MCZ).

Megalacron tabarensis warrenae, new subspecies.

Plate 9, fig. 3-4.

Description: Shell subglobose, imperforate and rather solid, reaching about 30 mm. in width. Whorls 4½ to 4¾, strongly convex and with a minor keel developed at the periphery. Shell egg shell-white, the color pattern consisting of two spiral bands of reddish brown, one just above and the other just below the whorl periphery. These bands vary considerably in width and intensity. In addition there may be irregular brownish zigzag lines between the upper band and the suture and rarely they may occur between the lower band and the base of the shell. When viewed with transmitted light the brown areas are translucent and the white opaque. In a large series the banded forms with the zigzag lines are far more abundant. Sculpture consisting of very fine interrupted striae which slant diagonally across the whorl. Periostracum very thin, pale yellow and deciduous.

Height	Width	
19 mm.	26 mm.	Holotype.
19 mm.	30 mm.	Paratype.
19.5 mm.	27 mm.	,,
16.5 mm.	22.5 mm.	,,

Types: Holotype, American Museum of Natural History no. 111300 from Boang Island, Tanga Group, off the east coast of New Ireland, Bismarck Archipelago, W. F. Coultas, collector, Whitney South Sea Expedition; paratypes, MCZ no. 181333; 181334.

Remarks: This subspecies is closely allied to *tabarensis* but differs in being more globose and in having a greater development of the banded forms and having the zigzag markings smaller and much more irregular.

Named for the late Mrs. Fiske Warren, who was much interested in tree snails. We had the use of her collection, and later this collection was donated to the Museum of Comparative Zoology.

Megalacron tabarensis anirensis (Rensch).

Plate 8, fig. 2-3.

Papuina lambei anirensis Rensch, 1934, *Archiv für Naturgeschichte N.F.*, 3:451 (Anir Island, S.E. of New Ireland, Bismarck Archipelago); Zilch, 1960, *Archiv für Molluskenkunde*, 89:193, pl. 17, fig. 21 [Holotype, Senckenberg Museum no. 7580.]

Description: We have not seen this subspecies. The following is a translation by J. C. Bequaert of the original diagnosis. "On the volcanic island Anir, S.E. of Neu Mecklenburg, which was also visited by the Hansa South Sea Expedition in 1909 . . . there developed a race, which becomes clear through the similar shape of the 4 specimens before me. The zigzag markings, almost as fine as in the specimens of *tabarensis*, are however almost colorless hyaline, only the brown stripe above and below the carina is strongly colored and contrasts with the whitish ground color of the shell. Size and shape agree with those of the typical race."

Remarks: On the basis of the description and the figures of the holotype (Zilch, 1960) it is a member of the *tabarensis* complex. According to Rensch it varies in its measurements from 18.5 mm. to 20.9 mm. in height and from 25.5 mm. to 29 mm. in greater diameter.

Megalacron spadicea (Fulton).

Plate 8, fig. 13; Plate 9, fig. 7.

Papuina spadicea Fulton, 1902, *Ann. Mag. Nat. Hist.*, (7), 9:318 (Neu Mecklenburg Island [New Ireland], Bismarck Archipelago, C. Wahnes, collector). [Holotype, BMNH no. 1902.5.28.34; paratypes, MCZ no. 159151; ANSP no. 84651.]

Papuina humilis Fulton, 1902, *Ann. Mag. Nat. Hist.*, (7), 9:317 (Nusa, Neu Mecklenburg [New Ireland], Bismarck Archipelago, C. Wahnes, collector). [Holotype, BMNH 1902.5.28.36; paratypes, USNM no. 220053; MCZ no. 92352; 159152; 187549; ANSP no. 84652.]

Description: Shell depressed-turbinate, imperforate, with a blunt keel and minutely sculptured. Color a light golden brown with a slightly darker spiral band just below the periphery and occasionally with a lighter band at the periphery. Spiral bands when present are indistinct. There is a darkened area just behind the lip. Whorls 5 to 5½, strongly convex and bluntly keeled. Spire conic and produced at an angle of 93°. Aperture subcircular, the outer lip reflected and somewhat irregularly curved. Inner lip consisting of a thin glaze. Columella short and arched into the base of the lip. Sutures indented. Sculpture consisting of very fine, irregular, incremental lines.

Height	Width	
19 mm.	27 mm.	Paratype (*humilis*).
20 mm.	25.5 mm.	,, ,,
19 mm.	26 mm.	,, ,,
20.5 mm.	28 mm.	,, (*spadicea*).
22 mm.	25 mm.	,, ,,
21.5 mm.	29 mm.	Kavieng, New Ireland.

Remarks: Both *humilis* and *spadicea* were described by Fulton based upon material collected by C. Wahnes. *M. humilis* came from Nusa, a small island just off Kavieng. Fulton did not localize the type locality of *spadicea* beyond New Ireland. We have, however, a series of this species collected at Kavieng, and we here limit the type locality to this place. So far as we can see, *humilis* is but a minor race of *spadicea*, the only difference being its slightly smaller size and the lack of the faint spiral bands possessed by *spadicea*. However, the presence or absence of the bands has little value, as this variation is quite common and banded and bandless forms occur in the same population in most other species in this complex.

Specimens examined: NEW IRELAND: Nusa Islet (MCZ; ANSP; USNM); Kavieng (MCZ; ANSP).

Megalacron spadicea dunckeri (Leschke).
Plate 8, fig. 8; Plate 9, fig. 5-6; text fig. 2.

Papuina dunckeri Leschke, 1912, *Jahrbuch der Hamburg Wissensch. Anstalten*, 29:105, fig. 7 (St. Matthias [Mussau] Island, Bismarck Archipelago).

Papuina enaiensis Leschke, 1912, *Jahrbuch der Hamburg Wissensch. Anstalten*, 29:106, fig. 8 (St. Matthias [Mussau] Island, Bismarck Archipelago).

Papuina lambei matthiae Boettger, 1918, *Abhandlungen Senckenbergischen Naturforschenden Gesell.*, 36:294, pl. 23, fig. 18a-c (small island near St. Matthias [Mussau Island, Bismarck Archipelago]). [Lectotype, Senckenberg Museum no. 5939.]

Description: Shell depressed-turbinate, imperforate, moderately to strongly keeled and minutely sculptured. Color a light golden brown with one or two spiral bands of dark brown, one above and one below the periphery. When only a single band is present, it is always below the periphery. All other characters appear to be the same as in the typical form. Rarely there are specimens which have developed numerous zigzag marks.

Height	Width	
17 mm.	29 mm.	Mussau Island, St. Matthias Group.
18 mm.	27.2 mm.	,, ,, ,,
19 mm.	27.5 mm.	Emirau ,, ,,

Remarks: This subspecies is very close to *M. spadicea* Fulton. It differs in being a little more depressed and in having the bands, when present, regular and darker in color. Other characters are the same as those of the typical form. Leschke's variety *enaiensis* is only a more strongly keeled specimen, but this character is variable as our present series illustrates, and *matthiae* Boettger appears to be an absolute synonym of *dunckeri*.

Head and dorsal part of the body a uniform tan. Edge of mantle and sole of foot pale ivory. The jaw, denticles of the radula and the reproductive system are shown in text figure 2(a-e). The jaw is moderately ribbed (a); the denticles of the radula (b) arranged in staggered V-shaped rows. The vas deferens extremely thick expecially at its upper end near the prostate gland. The penis (d) is small, thin, and internally has three low fleshy pilasters running its entire length. There is a long, thin penis papilla, shown enlarged in (e).

Specimens examined: MUSSAU ISLAND: Emirau Island (both MCZ; USNM; ANSP); Bolin; Tasitel; 7 km. WSW of Tabol (all UMK).

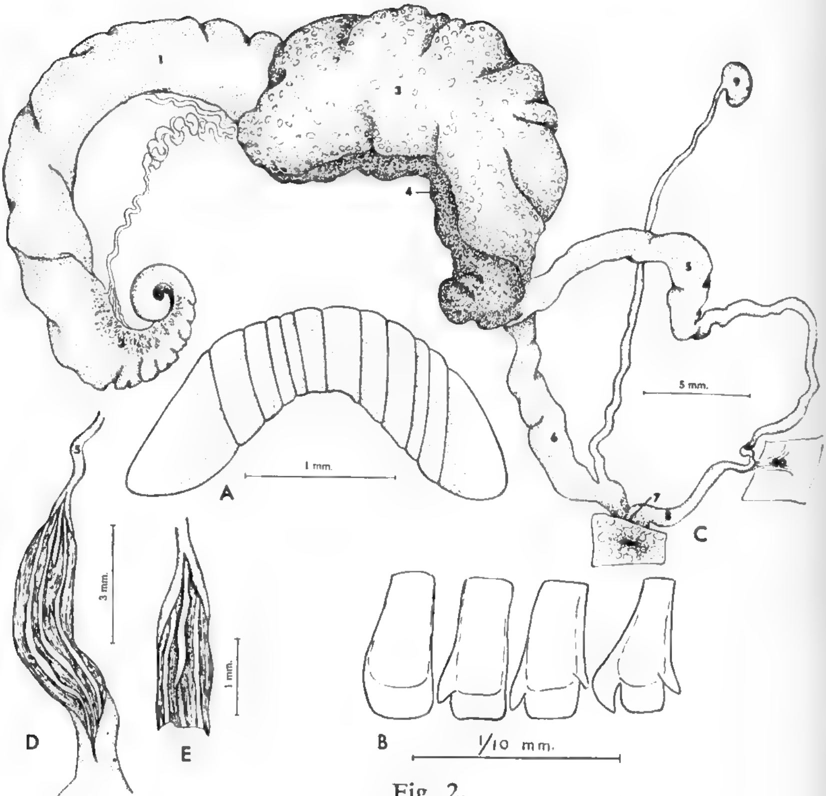


Fig. 2.
Megalacron spadicea dunckeri (Leschke). A, jaw. B, radular teeth. C, complete reproductive system. D, dissected penis. E, upper end of penis enlarged to show the slender penis papilla. (See figure 1 for labelling of the reproductive system.)

Megalacron juttingae, new species.

Plate 9, fig. 8.

Description: Shell trochiform, imperforate, strong and very finely sculptured. Ground color white. Whorl periphery with a white, spiral band, margined above and below by narrow black bands, and these two bands margined by two somewhat broader bluish bands. Whorls 5½ and strongly convex. Spire elevated and produced at an angle of 70°. Aperture subovate and cast at an angle of about 30° from the base. Parietal wall thinly glazed. Palatal lip broad and reflected. Columella short and arched to the right and moderately keeled on its inner edge. Suture well defined and slightly indented. Sculpture consisting of exceedingly fine, irregular incised lines which are diagonal above the periphery and spirally arranged below.

Height	Width	
24 mm.	28 mm.	Holotype.

Types: Holotype, University Museum, Kobenhavn, Denmark, from the "Noona Dan" Expedition: Kalili Bay (3°27'S; 151°56'E), New Ireland, Bismarck Archipelago, May, 1962. A single, inmature, dead paratype was collected 10 miles south-east of Kalili Bay, New Ireland, Mus. Comp. Zool. no. 248834.

Remarks: This species apparently is not closely related to any other species in the *lambei* complex. The peripheral bands on the early whorls are brownish but as the shell grows the bands become darker and are black upon maturity. It is our pleasure to name this species for Dr. W. S. S. van Benthem Jutting of the Zoologisch Museum, Amsterdam, in recognition of her excellent publications on the land and freshwater mollusks of Indonesia and Melanesia.

Megalacron boyerii (Fischer and Bernardi).

Plate 10, fig. 13.

Helix boyerii Fischer and Bernardi, 1856, *Jour. de Conchy.*, 5:297, pl. 9, fig. 8-9 (les îles de l'Amirante [Admiralty Islands]).

Helix (*Papuina*) *boyerii* Fischer and Bernardi. Pilsbry, 1891, *Man. of Conch.*, (2), 7:47, pl. 13, fig. 48-49 (Louisiade Islands).

Description: Shell trochiform, imperforate, strong and finely sculptured. Ground color a pale ivory, seen mainly as narrow peripheral and sutural bands; remainder of shell a straw-yellow which generally becomes a little darker where it margins the peripheral band of white. Whorls 5, strongly convex and with a slightly developed peripheral keel. Spire elevated and produced at an angle of about 70°. Aperture subquadrate and cast at an angle of 25°. Parietal wall thinly glazed. Palatal lip white and reflected. Columella arched to the right, rather broad and moderately keeled on its inner edge. Suture well indented. Sculpture consisting of exceedingly fine, irregular, incised lines, diagonal above the periphery and spirally arranged below. Protoconch poorly defined and not sculptured.

Height	Width	
22 mm.	26.5 mm.	Woodlark Island, New Guinea.
23 mm.	27.2 mm.	,, ,,

Remarks: Many species of land and freshwater mollusks described during 1840-1890 had erroneous locality data. Both of the localities given above in the references are in error. This species does not occur in the Admiralty or the Louisiade groups, but is known only from Woodlark Id., off the north-east coast of New Guinea.

Its type of coloration would place it in the *M. lambei* group and somewhat similar to the *spadicea—dunckeri* complex of northern New Ireland and Mussau Island.

Specimens examined: WOODLARK IDS.: (MCZ; AM; USNM).

Megalacron alfredi (Cox).

Plate 8, fig. 7; Plate 10, fig. 6.

Helix alfredi Cox, 1871, *Proc. Zool. Soc. London*, p. 323, pl. 34, fig. 1-1a (Solomon Islands). [Holotype, Australian Mus. no. C.62688.]

Helix (Merope?) barnaclei E. A. Smith, 1877, *Ann. Mag. Nat. Hist.*, (4), 20:242 (Hawaii, Sandwich Islands). [Lectotype, British Mus. no. 77.7.14.1.]

Helix alfredi trichroa v. Martens, 1881, *Conchologische Mittheilungen*, 1:5, pl. 2, fig. 8-10 (New Ireland). [Holotype, Berlin Mus.]

Description: Shell moderately depressed, imperforate, light in structure and smooth. Ground colour light ivory or pale brown and generally with one or more spiral bands of a dark blackish brown. These dark bands vary greatly in their width on different specimens and occasionally broaden to the extent that the shell is nearly all blackish brown. The

most abundant form appears to be one with two narrow bands at the periphery, the peripheral area being either ivory or light brown. Whorls 4½ to 5, and strongly convex. Spire slightly elevated and produced at an angle of 95° to 115°. Aperture subcircular to subquadrate and cast at an angle of about 45°. Parietal wall thinly glazed. Palatal lip narrow and reflected. Columella arched. Suture defined and slightly impressed. Sculpture consisting of very fine growth lines, the usual, minute incised lines being absent in this species. Protoconch not separable from the remainder of the shell.

Height	Width	
21.5 mm.	29 mm.	Bougainville Id., Solomon Islands.
22 mm.	32.5 mm.	,, ,,
17.5 mm.	30 mm.	,, ,,
22.5 mm.	30.5 mm.	Buin, ,, ,,
19 mm.	31.5 mm.	Buka Id., ,, ,,
14 mm.	22 mm.	,, ,, ,,

Remarks: A variable species in both coloration, shape and size. So far as known this species is limited to Bougainville and Buka Islands, Solomon Islands. Buka is a small island just off the north-western end of Bougainville. The earlier records of Hawaii and New Ireland are erroneous.

Megalacron alfredi (Cox) is not a typical member of this genus. It is admitted here because it possesses the coloration pattern of the species group of *M. lambei* (Pfr.) and by its shape. It is divergent from this group by being smooth, with no indication of the very fine microscopic sculpture found in other members of this species complex. It is also totally different from any other Solomon Islands group. Nothing is known of its soft anatomy.

Specimens examined: BOUGAINVILLE: Buin; Buka Id. (both MCZ).

Species Group of *Megalacron phaeostoma* v. Martens.

This species complex is characterized by shells which are attenuated, lack whorl peripheral bands, possess the zigzag color markings and are rounded or strongly keeled at the whorl periphery.

Megalacron bequaerti, new name.

Plate 9, fig. 10.

Helix gaberti of authors, not of Lesson, 1830.

Helix trochus Quoy and Gaimard, 1832, *Voyage de l'Astrolabe, Zoologie*, 2:100, pl. 8, fig. 5-7 (Carteret Harbor, New Ireland); non *H. trochus* Müller, 1821.

Helix trochoides 'Quoy' Deshayes, 1838 [in] *Histoire Naturelle Animaux Sans Vertebres*, 2nd ed., 8:122 [new name for *H. trochus* Quoy, 1832; non *H. trochus* Müller, 1821]; non *H. trochoides* Poiret, 1789; Gmelin, 1790.

Description: Shell reaching about 28 mm. in greater diameter, trochoid in shape, light in structure, imperforate, bluntly keeled and minutely sculptured. Whorls 6, nearly flat-sided and bluntly carinated. Color consisting of a yellowish brown base overlaid with numerous irregular oblique bars of dark reddish brown. There is a clear area at the whorl periphery. Occasional specimens have 2 spiral bands, one above and one below the periphery which, however, are not very sharply defined. Spire extended and produced at an angle of 70°. Aperture subcircular and cast at an angle of about 50°. Outer lip white and reflected. Inner lip consisting of a very thin glaze. Columella slightly angled and somewhat widened. Suture slightly indented. Sculpture consisting of very fine, irregular, oblique, incised lines which are crossed by very fine growth lines.

Height	Width	
22 mm.	23 mm.	New Ireland.
28 mm.	27.5 mm.	"
27 mm.	28.5 mm.	"

Types: This species is probably limited to the southern end of New Ireland. We here select Carteret Harbor to be the type locality and the specimen upon which the figures of Quoy and Gaimard of *Helix trochus* were based to be the lectotype.

Remarks: This species is figured beautifully by Quoy and Gaimard. It has long been known under the name of *Papuina gaberti* Lesson. However, this latter species came from Dore, Geelvink Bay, New Guinea, and is in no way related to *M. bequaerti* from New Ireland in the Bismarck Archipelago. Also, Lesson describes a shell which is much wider than high and strongly keeled, characters which do not apply to *Megalacron bequaerti*.

We introduce the name *bequaerti* as a new name for *Helix trochoides* Deshayes, 1838, which is preoccupied by Poiret, 1789, and Gmelin, 1790. We take pleasure in naming this species after our colleague and co-worker, Dr. J. C. Bequaert. See remarks under *M. phaeostoma* von Martens.

Specimens examined: New Ireland (MCZ).

Megalacron phaeostoma (v. Martens).

Plate 8, fig. 12, 14-15, 16-17; Plate 9, fig. 11-12; text fig. 3.

Helix (Papuina) phaeostoma v. Martens, 1877, *Monatsbericht der Königlich-Preussischen Akademie der Wissenschaften zu Berlin,* p. 276, pl. 1, fig. 10-11 (Wasserhafen, Neu Hanover, Bismarck Archipelago); Pfeiffer, 1877, *Novitates Conchologicae,* (1), 5:32, pl. 144, fig. 13-14. [Holotype, Berlin Museum.]

Papuina phaeostoma densepicta Rolle, 1902, *Nach. der Deutschen Malak. Gesell.,* 34:212 (Kung Id., near New Hanover, Bismarck Archipelago). [Lectotype, SMF no. 8654; Syntype, MCZ no. 157457.]

Papuina phaeostoma raremaculata Rolle, 1902, *Nach. der Deutschen Malak. Gesell.,* 34:212 (Kung Id., near New Hanover, Bismarck Archipelago). [Lectotype, SMF no. 8653; Syntype, MCZ no. 157458.]

Papuina phaeostoma fulgurata Rolle, 1902, *Nach. der Deutschen Malak. Gesell.,* 34:212 (Kung Id., near New Hanover, Bismarck Archipelago). [Lectotype, SMF no. 8652; Syntype MCZ no. 183769.]

Papuina phaeostoma gracilis Blume, 1920, *Archiv für Molluskenkunde,* 52:129 (Bismarck Archipelago).

Papuina phaeostoma pallida Blume, 1920, *Archiv für Molluskenkunde,* 52:129 (no locality given).

Description: Shell reaching about 28 mm. in greater diameter, trochoid in shape, light in structure, imperforate, rounded at the periphery and minutely sculptured. Whorls 5½ and moderately convex. Color pattern variable but generally consisting of numerous irregular bars of dark reddish brown on a straw-yellow background. There is a clear area forming a band at the periphery. Spire extended and produced at an angle of about 75°. Aperture subcircular and cast at an angle of about 50° from the base. Outer lip usually brownish and well reflected. Inner lip consisting of a very thin glaze. Columella angled, broad, and occasionally producing a tooth-like ridge on its inner margin. Suture slightly indented. Sculpture consisting of very fine irregular, oblique, incised lines which are crossed by exceedingly fine growth lines.

Height	Width	
26.5 mm.	24.5 mm.	Kung Id., New Hanover, Bismarck Archipelago.
27.5 mm.	28.5 mm.	Kung Id., New Hanover, Bismarck Archipelago.
26 mm.	23.5 mm.	New Hanover, Bismarck Archipelago.

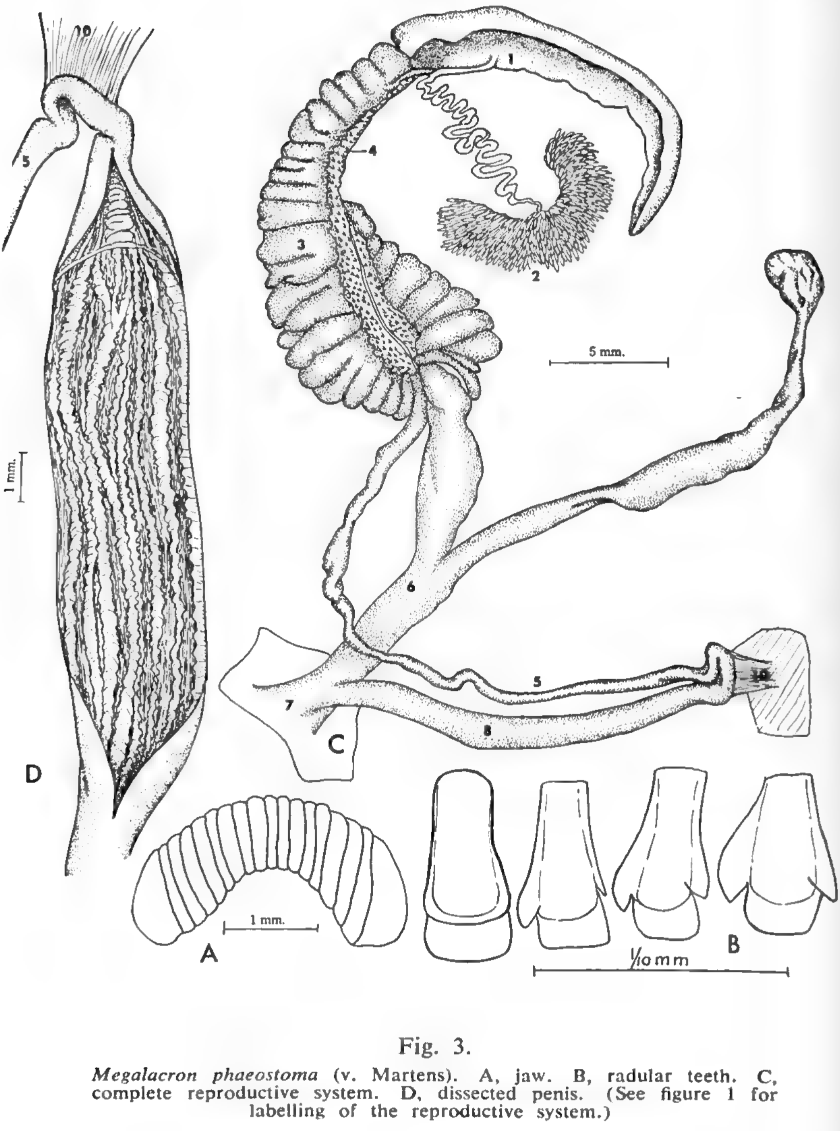


Fig. 3.

Megalacron phaeostoma (v. Martens). A, jaw. B, radular teeth. C, complete reproductive system. D, dissected penis. (See figure 1 for labelling of the reproductive system.)

Remarks: This species, as well as others in this complex, show a remarkable range in the variation of the color pattern as well as a moderate range in shape and size. The several synonyms above by Rolle are based upon nothing more than selected examples which occur within the color range and all were collected on Kung Islet, New Hanover Island. This species is close to *M. bequaerti*, but differs by having the periphery of the whorls rounded rather than keeled, having a brownish lip and having the columella broader and sometimes having a ridge-like tooth on the columella and extending to the base of the lip. The color pattern is quite similar.

Head and upper part of foot dark brown to nearly black with reticulate markings of light tan. Sole of foot and a narrow band just in from the edge of the mantle light tan. Mantle and spire a medium red brown. The jaws, denticles of the radula and the reproductive systems are shown in text figure 3 (a-d). The jaws (a) are very lightly ribbed; the denticles of the radula arranged in staggered V-shaped rows. Two specimens were dissected. The uterus was exceedingly large, particularly at its lower end so that in order to show the prostate gland it was necessary to turn the section over in the illustration. The penis is very long, thin, with a muscular wall and numerous irregular pilasters on the inner side.

Specimens examined: New Hanover: Kung Island (BM; MCZ); Banatum (UMK; MCZ).

Megalacron phaeostoma mediensis (Rensch).
Plate 9, fig. 13-15.

Papuina phaeostoma mediensis Rensch, 1934, *Archiv für Naturgeschichte N.F.*, 3:455, fig. 4 (Medina, New Ireland, Bismarck Archipelago). [Holotype, Basel Museum; paratypes, MCZ no. 156954.]

Papuina phaeostoma lamassongensis Rensch, 1934, *Archiv für Naturgeschichte N.F.*, 3:455, fig. 4 (Lamassong and Fatmilak, New Ireland, Bismarck Archipelago). [Holotype, Basel Museum; paratypes, MCZ no. 156951.]

Papuina phaeostoma kandanensis Rensch, 1934, *Archiv für Naturgeschichte N.F.*, 3:456, fig. 4 (Kandan, New Ireland, Bismarck Archipelago). [Holotype, Basel Museum; paratype, MCZ no. 59849.]

Description: This subspecies is exceedingly close to typical *M. phaeostoma*. It differs in being proportionately wider, the whorls a little more swollen, the sutures more indented. In all other respects it is like the typical species. There is a wide range of variation in color intensity, the color ranging from nearly pure creamy white to a dark mahogany brown. Specimens intermediate between these two extremes show a color pattern similar to that of *M. phaeostoma*.

Height	Width	
25.4 mm.	27.5 mm.	Medina, New Ireland.
25 mm.	28.2 mm.	Kandan, ,,
30 mm.	31 mm.	Lamassong, ,,

Remarks: As noted under the description, there is a slight difference between this subspecies and the typical form, particularly in being wider than high and in having the whorls a little more globose. In our opinion, the three names given in the synonymy above all refer to the same subspecies. All are from localities that are close together and they appear to us to be nothing but minor population variations.

Specimens examined: New Ireland: Medina; Kandan; Lamassong; Fatmilak (all Basel Museum and MCZ).

Megalacron admiralitatis (Rensch).
Plate 11, fig. 4-6; text fig. 4.

Papuina admiralitatis Rensch, 1931, *Zool. Anzeiger,* 95:188, text fig. 3 (Manus Island, Admiralty Islands). [Holotype, Berlin Museum.]

Description: Shell extended, conical, imperforate, rather light in structure and reaching 30 mm. in diameter. Whorls 5½, moderately convex and having a blunt keel. Color a dull ivory and striped with numerous dark brown, zigzag axial bars of color. Occasional specimens with the zigzag markings much reduced or lacking. Spire extended and produced at an angle of 75°. Aperture subovate, outer lip reflected and

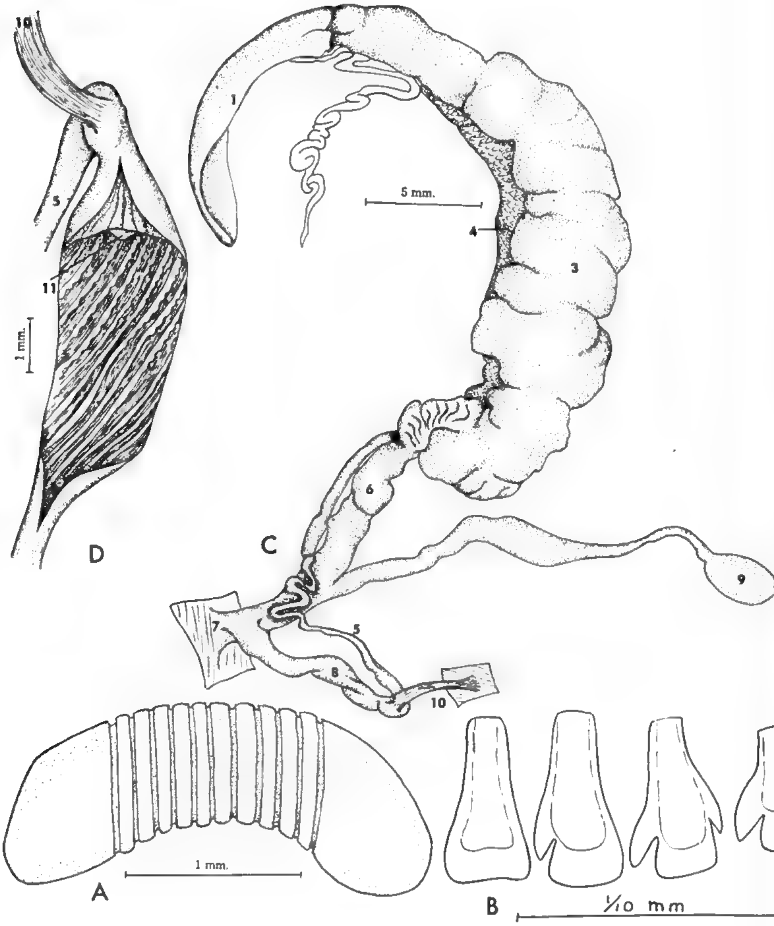


Fig. 4.

Megalacron admiralitatis (Rensch). A, jaw. B, radular teeth. C, complete reproductive system. D, dissected penis. (See figure 1 for labelling of the reproductive system.)

white. Inner lip consisting of a very thin glaze on the parietal wall. Aperture produced at an angle of about 40° from the base of the shell. Columella angled and sloping to the right to the base of the shell, forming a thin ridge-like tooth. Suture well defined. Sculpture consisting of very fine, wavy, irregular threads and crossed by exceedingly fine growth lines.

Height	Width			
23.5 mm.	30 mm.	Drabui,	Manus Id.,	Admiralty Ids.
23.5 mm.	27.5 mm.	Malai,	„	„
25 mm.	26.5 mm.	Petaiya,	„	„

Remarks: This is a very distinctive species in this difficult complex. In relationship it appears nearest to *M. phaeostoma* v. Martens from New Hanover. It differs from this species by being proportionately wider and having much finer markings. It is also related to *M. densestriata*.

Head and dorsal part of body a uniform brown; eye stalks brown. Muscular edge of mouth and sole of foot ivory. The inner surface of mantle edge mottled with grey, and the sole of the foot greying toward the edge. The jaws, denticles of the radula and reproductive anatomy are shown in text figure 4 (a-d). The jaws are strongly ribbed and the denticles of the radula arranged in V-shaped rows. Three specimens were dissected. The penis is long and slender, the interior with more or less diagonally arranged, low, thin pilasters which are smooth at the lower end but scalloped at the upper end.

Specimens examined: MANUS ISLAND: Drabui; Petaiya; Tavi; Malai (all MCZ; AMNH); Lorengau (MCZ; UMK); Pundrau (BPBM); Lundren (UMK).

Megalacron melanesia, new species.

Plate 10, fig. 14; text figure 5.

Description: Shell extended, conic, trochiform, rather light in structure, imperforate and finely sculptured. Whorls 5, flat sided and acutely keeled. Color a dark chocolate-brown, a few specimens being a light brown and a few of the darker ones showing the zigzag markings so characteristic of this species group. Spire moderately extended and produced at an angle of 70°. Aperture subquadrate and produced at an angle of 45° from the base. Parietal wall thinly glazed. Palatal lip broadly reflected. Columella sloping and slightly wider than the outer or palatal lip. Suture well defined but only slightly indented. Sculpture consisting of very fine, irregular, incised lines which are diagonal above the whorl periphery and spirally arranged below. Periostracum thin, yellowish and deciduous.

Height	Width	
20 mm.	26.5 mm.	Holotype.
20.5 mm.	26 mm.	Paratype.
19 mm.	23 mm.	„
19 mm.	26 mm.	„
20 mm.	24 mm.	„

Types: The holotype is in the University Zoological Museum, Kobenhavn, and is from the "Noona Dan" expedition from the Waterfall, Lorengau, Manus Island, Admiralty Islands, Bismarck Archipelago, June 16, 1962. Paratypes from the same locality are in the same institution and in the Museum of Comparative Zoology no. 249306.

Remarks: In relationship, this species is probably nearest to *Megalacron admiralitatis* Rensch which also occurs on Manus Island. The relationship is indicated in the similar sculpture. Similar shape and the similar but relatively indistinct zigzag markings. It differs from *admiralitatis* in having a very acute keel, flatter whorls and a far less pronounced columellar ridge. It differs from *M. densestriata* Fulton by having very different sculpture and in being less attenuated.

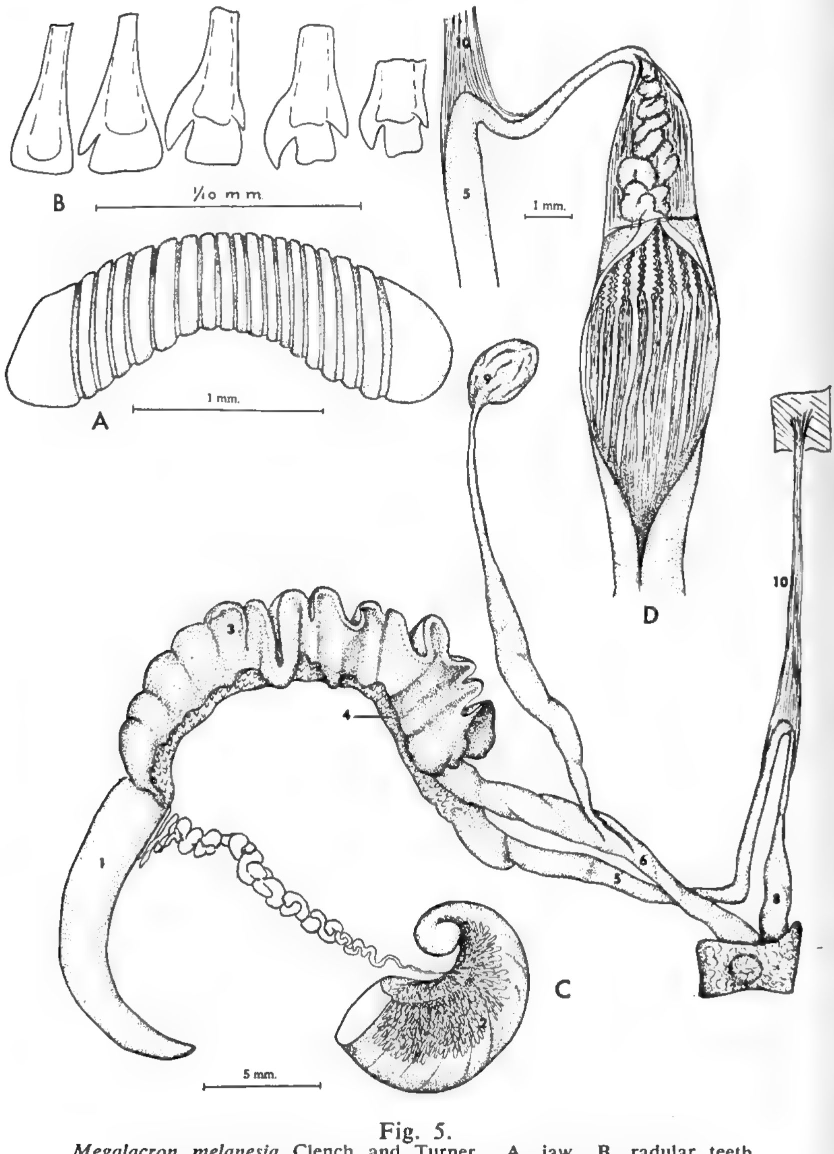


Fig. 5.
Megalacron melanesia Clench and Turner. A, jaw. B, radular teeth. C, complete reproductive system. D, dissected penis. (See figure 1 for labelling of the reproductive system.)

Head and dorsal part of the body a dark brownish grey. The muscular edge of the mantle yellowish tan, darker brown-grey behind. Sole of foot light tan. A light grey, more or less diamond shaped spot is located between and just behind the eye. The jaw, denticles of the radula and the reproductive organs are shown in text figure 5 (a-d). The jaw is heavily ribbed (a); the denticles of the radula arranged in staggered V-shaped rows. Five specimens were dissected. The uterus was thin, high and arranged in deep loops. The penis is small, thin walled and with 10 to 12 pilasters extending the entire length; these were broad and jagged at the upper end. Epiphallus rather large, thin walled and with a large, irregularly coiled pilaster.

Megalacron densestriata (Fulton).

Plate 10, fig. 5.

Papuina densestriata Fulton, 1902, *Ann. Mag. Nat. Hist.*, (7), 9:316 (Neu Mecklenburg [New Ireland], Bismarck Archipelago). [Holotype, British Mus. no. 1902.5.28.24; paratypes, Mus. Comp. Zool. no. 159153 and 187548; USNM; UM; ANSP.]

Description: Shell extended, conic, rather light in structure and reaching about 29 mm. in length, imperforate and finely costate. Whorls 6, slightly convex and with the last whorl having a slight keel at the periphery. Color dark, chocolate-brown, occasionally mottled with lighter brown and usually having a narrow band of light brown at the periphery. Lip and columella a dark, shiny brown with the inner margin of the columella and the extreme outer edge of the reflected lip being ivory. Spire extended and produced at an angle of about 60°. Aperture subquadrate, parietal lip consisting of a very thin glaze. Palatal lip reflected, broadly and slightly indented at the peripheral area and produced at an angle of 50° from the base. Columella sloping and rather broad. Suture well defined. Sculpture consisting of numerous and fine costae which are set obliquely. Protoconch consisting of 1½ whorls and smooth.

Height	Width	
28.5 mm.	25.8 mm.	Paratype.
24 mm.	23.5 mm.	„
27.5 mm.	22 mm.	„

Remarks: This is a very distinctive species and though the color is dark, obscuring much of the pattern, it is typical of the genus. It differs from all other species of *Megalacron* by being rather coarsely sculptured with diagonal riblets. It appears nearest in relationship to *M. admiralitatis* Rensch of Manus Island, Admiralty Islands.

Specimens examined: New Ireland (MCZ; USNM; ANSP; UM).

Megalacron periwonensis (Dell).

Plate 10, fig. 3.

Papuina (*Pinnadena*) *periwonensis* Dell, 1955, *Pacific Science*, 9:327, text figure 2b-d (near Periwon Village, Nissan Island, Solomon Islands). [Holotype, Dominion Mus. no. MF 2507; paratype, Museum Comp. Zool. no. 190125.]

Description: Shell subdepressed, trochiform, strongly carinate, minutely sculptured and imperforate. Whorls 5, flattened and very sharply keeled. Color yellowish white with numerous brown diagonal and some-

what irregular bars of color. Spire low and produced at an angle of 98°. Aperture subquadrate and produced at an angle of 45° from the base. Outer lip widely reflected and pointed at the termination of the carina; inner lip consisting of numerous oblique and irregular depressions and ridges. Protoconch whorls 2 and smooth.

Height	Width	
19.1 mm.	28 mm.	Holotype.
19.5 mm.	27.8 mm.	Paratype.
19.5 mm.	26.3 mm.	,,
18.5 mm.	27.4 mm.	,,
19 mm.	25.2 mm.	,,

Remarks: This species is readily differentiated from others in this complex by having flattened sides to the whorls, a very sharp keel and by having only the irregular color bars. No spiral bands are present. It appears to be most closely related to *M. tabarensis lihirensis* (Rensch) from the Lihir Group of islands. It has somewhat similar irregular bars of coloring and both forms possess a well developed keel. However, *periwonensis* lacks completely the spiral bands of *lihirensis*.

Specimens examined: NISSON ISLAND: Periwon Village (DM; MCZ).

Species Group of *Megalacron novaegeorgiensis* (Cox).

This species complex is characterized by shells which are depressed and with few exceptions, spirally banded but with no indication of any zigzag color markings.

Megalacron novaegeorgiensis (Cox).

Plate 8, fig. 9-11; text figure 6.

Helix novaegeorgiensis Cox, 1870, *Proc. Zool. Soc. London*, p. 170, pl. 16, fig. 3 (New Georgia, Solomon Islands [Admiralty Islands, Bismarck Archipelago]). [Holotype, Australian Mus. no. C.62676.]

Helix (*Geotrochus*) *moseleyi* Smith, 1884, *Proc. Zool. Soc. London*, p. 263, pl. 22, fig. 2-2a (Wild Island, Admiralty Islands [about 5 miles N. of Moseley Point, Manus Island]). [Holotype, British Mus. no. 84.6.12.580; paratypes from the same locality are in the Mus. Comp. Zool. and the Acad. Nat. Sci. Phila.]

Description: Shell subdepressed, rather light in structure, imperforate, banded and reaching about 25 mm. in greater diameter. Whorls 3½ to 4, strongly convex and rounded at the periphery. Color a pale ivory white with one or more narrow spiral bands of chestnut brown. Specimens with 3 or 4 bands appear to be most abundant, though we have seen specimens with as many as 9 bands. Bandless forms are rare. Spire subdepressed, obtuse and produced at an angle of 110°. Aperture subcircular and descending. Parietal lip consisting of a very thin glaze. Palatal lip white, broad, somewhat thickened, reflected and produced at an angle of 45° from the base. Columella lightly thickened and arched. Suture well defined. Protoconch glass-like, nearly smooth and with exceedingly fine axial riblets. Later whorls finely rugose, the depressions and ridges running obliquely. Axial growth lines fine and slightly oblique.

Height	Width			
14.5 mm.	24.5 mm.	Drabui, Manus Islands,	Admiralty Ids.	
15.2 mm.	26.5 mm.	Tavi,	,,	,,
14.5 mm.	24.5 mm.	Malai,	,,	,,
13 mm.	22 mm.	Nauna Id.,	,,	,,

Remarks: So far as now known *M. novaegeorgiensis* (Cox) is limited to the Admiralty Islands in the Bismarck Archipelago, though originally described as coming from New Georgia in the Solomon Islands. This locality was certainly in error. It is closely related to *M. n. creta* of the Vitu Islands which lie some 175 miles to the south-east. This latter subspecies, though similar in structural details, is much larger. It is less closely allied to *M. lufensis* Thiele, a species known only from the Ninigo Group of Islands which are located about 150 miles north-west of the Admiralty Islands. *M. lufensis* is much smaller, more delicate in structure and has the spiral bands confined to the area mainly above the whorl periphery. There appears to be no question but that *M. novaegeorgiensis* Cox and *M. moselevi* Smith are the same species.

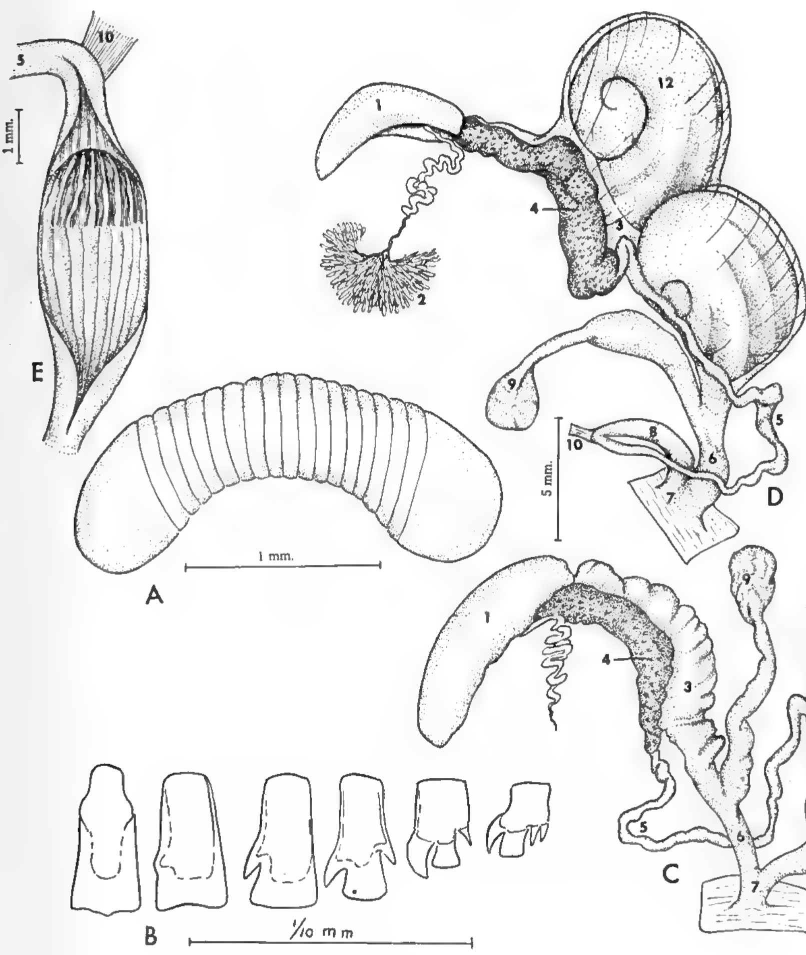


Fig. 6.

Megalacron novaegeorgiensis (Cox). A, jaw. B, radular teeth. C, reproductive system in non reproductive stage. D, complete reproductive system with two young in the uterus. (See figure 1 for labelling of the reproductive system.)

Head, foot and muscular edge of mantle all a uniform light tan with a band of darker greyish brown around the neck. The jaws, denticles of the radula and reproductive system are shown in text figure 6 (a-e). The jaws (a) are lightly ribbed and the denticles of the radula arranged in nearly straight rows. Four specimens were dissected, of which three had two large young shells in the uterus and these already showed color bands. One lacked any indication of young or division of the uterus into two chambers. The penis is small, slender, thin walled, the interior with only a few small fleshy pilasters at the upper end.

Specimens examined: ADMIRALTY ISLANDS: Tong Island (USNM); Rambutyo Island; Nauna Island (both AMNH and MCZ); MANUS ISLAND: Wild Island (BMNH; MCZ; ANSP); Pityilou Island (MCZ); Malai Village; Ravi Village; Drabui Village; Petaiya Village (all AMNH and MCZ); Tingau; Buyang; Pundrau (all BPBM); Lorengau (MCZ); Los Negros (MCZ; BPBM).

Megalacron novaegeorgiensis creta (Rensch).

Plate 10, fig. 4.

Papuina novaegeorgiensis creta Rensch, 1934, *Archiv. für Naturgeschichte N.F.*, 3:480 (Französischen Inseln [Vitu Islands] North of New Britain, Bismarck Archipelago). [Holotype, Berlin Mus.; paratype, Mus. Comp. Zool. no. 83856.]

Description: This subspecies is similar to the typical form but differs in being slightly larger and in having a small tooth at the base of the lip near its juncture with the columella. In the single paratype specimen which we have seen, the spiral bands are somewhat lighter in color.

Height	Width	
16.6 mm.	27 mm.	Holotype.
16.5 mm.	27 mm.	Paratype.

Remarks: See under *M. novaegeorgiensis* Cox.

Specimens examined: VITU ISLANDS: Unea (MCZ, ex B. Rensch).

Megalacron lufensis (Thiele).

Plate 10, fig. 1-2; text figure 7.

Papuina lufensis Thiele, 1928, *Zoologische Jahrbucher* (*Syst.*), 55:139, pl. 5, fig. 30 (Hermit and Maty Islands [Ninigo Group, Admiralty Islands]). [Holotype, Berlin Mus. from Hermit Id.]

Papuina lufuensis 'Thiele' Jutting, 1933, *Nova Guinea,* 17:53 [error for *lufensis* Thiele].

Description: Shell subdepressed, light in structure, imperforate, banded and reaching about 18 mm. in greater diameter. Whorls 3¼ to 3½, convex and slightly angulated at the periphery. Color a pale ivory to white with 4 to 7 spiral bands of dark brown which are generally confined to the area above the whorl periphery. A few specimens may have a band just a little below the periphery. Occasional specimens may lack these color bands, and in several the bands are interrupted. Spire depressed, obtuse and produced at an angle of 115°. Aperture subcircular and slightly descending. Parietal lip consisting of a very thin glaze. Palatal lip narrow, white, reflected, produced at an angle of 50° from the base and supporting a small, broad tooth at the base of the columella. Columella slightly thickened and angled toward the base of the lip. Suture well defined. Sculpture of the protoconch nearly smooth, having only very fine axial riblets. Later whorls finely rugose, the depression and ridges running obliquely.

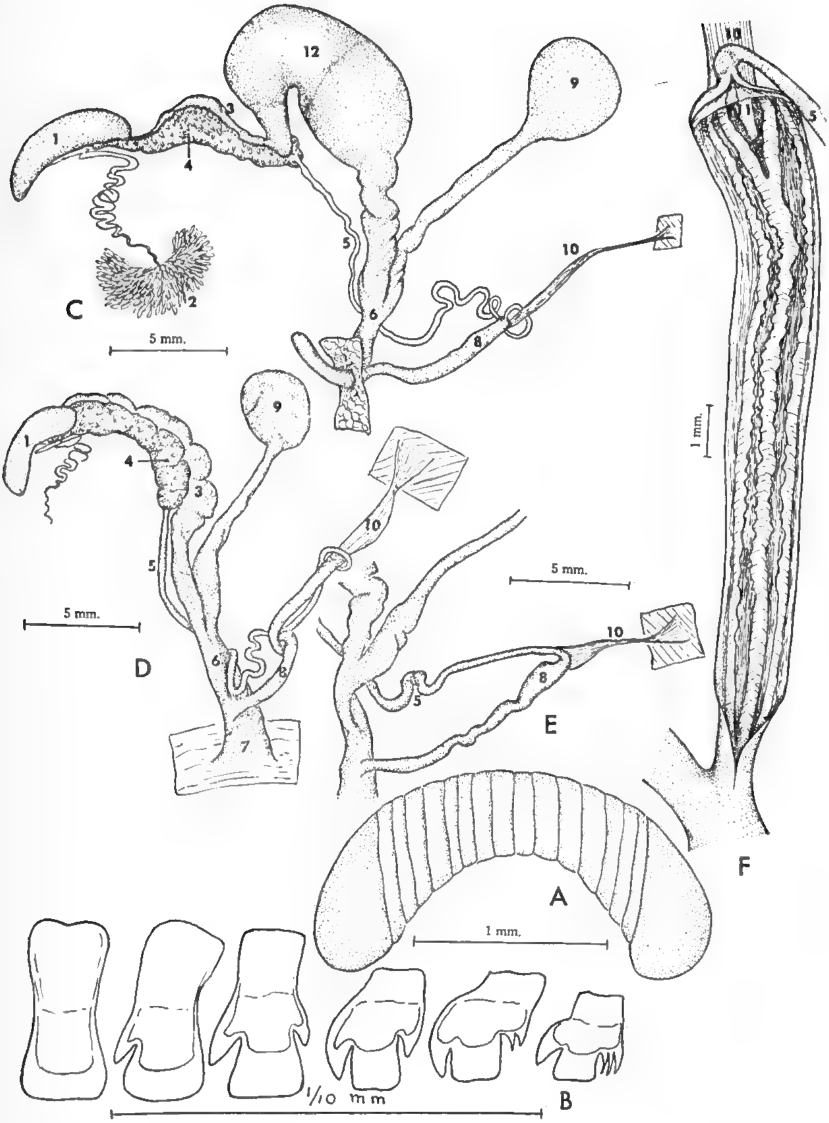


Fig. 7.

Megalacron lufensis (Thiele). A, jaw. B, radular teeth. C, complete reproductive system with two young in the uterus. D, reproductive system in non reproductive stage. E, basal area with penis and vas deferens separated. F, dissected penis. (See figure 1 for labelling of the reproductive system.)

Height	Width	
12 mm.	19 mm.	Maty Island (Thiele).
11 mm.	18 mm.	Hermit Island (Thiele).
11 mm.	19 mm.	Lau Island.
9.5 mm.	15.5 mm.	,, ,,
11.2 mm.	19.5 mm.	Pihan Island.

Remarks: See also under *M. novaegeorgiensis* Cox.

Animal entirely a uniform light ivory; eye stalks ivory at the base, a red-brown at the tips. The jaws, denticles of the radula, and the reproductive system are shown in text figure 7 (a-e). The jaw is lightly and unevenly ribbed; the denticles on the radula are arranged in nearly straight rows which are not offset. In the 4 specimens dissected the spermatheca was proportionately very large, the oviduct and vagina long and the penis very long. Figure 7(c) illustrates a specimen in which the vas deferens and penis are in the normal position. Figure 7(d) illustrates one in which the vas deferens has been moved to one side and the penis has been uncoiled to show the point of entrance of the vas deferens and the point of attachment of the penial retractor muscle.

Specimens examined: NINIGO GROUP: Hermit Island (ANSP; UMK); Pihan Island; Lau Island (both AMNH and MCZ).

Megalacron klaarwateri (Rensch).

Plate 10, fig. 7-12; text fig. 8.

Papuina klaarwateri Rensch, 1931, *Zoologischer Anzeiger,* 95:187, text fig. 2 (Manus Island, Admiralty Islands). [Holotype, Berlin Mus.]

Description: Shell reaching about 20 mm. in greater diameter, depressed-globose, imperforate, rather thin, shiny and minutely sculptured. Color pattern variable, pale yellow or brown below; canary yellow or dark mahogany brown above, or with brown bands on a yellow background, or straw-yellow to light brown bands on a dark brown background. Aperture subcircular with a slightly reflected lip. Columella broadened as a flattened ridge. Whorls four, rather strongly convex and the last one slightly constricted behind the lip.

Height	Width	
12 mm.	19.5 mm.	Tavi Village, Manus Island.
13 mm.	20 mm.	,, ,,
15 mm.	21 mm.	Drabui Village, ,,

Remarks: There are three rather definite colour forms of this species, the typical form being banded alternately with canary yellow and dark mahogany brown. The base color may be straw yellow to mahogany, though the latter never appears to be quite as dark as the bands, and this is only a result of diffusion. The second form is a bright canary yellow, opaque above the periphery; a duller translucent yellowish below. This third form is a dark mahogany brown with a yellowish brown band at the suture. Below the periphery the brown is less intense and somewhat translucent with faint indications of exceedingly narrow brownish bands. There may be some genetic value to these color forms. The typical striped form and the canary yellow form existed together at all the localities collected by the Whitney South Sea Expedition; the dark brown form occurred with the other two only at a single locality. These forms apparently do not exist as a species complex, but as a single species in which these color elements are segregated. This condition is, of course, well known in many other groups of land shells, namely *Liguus, Polymita,* and, of course, other elements of the *Papuininae.*

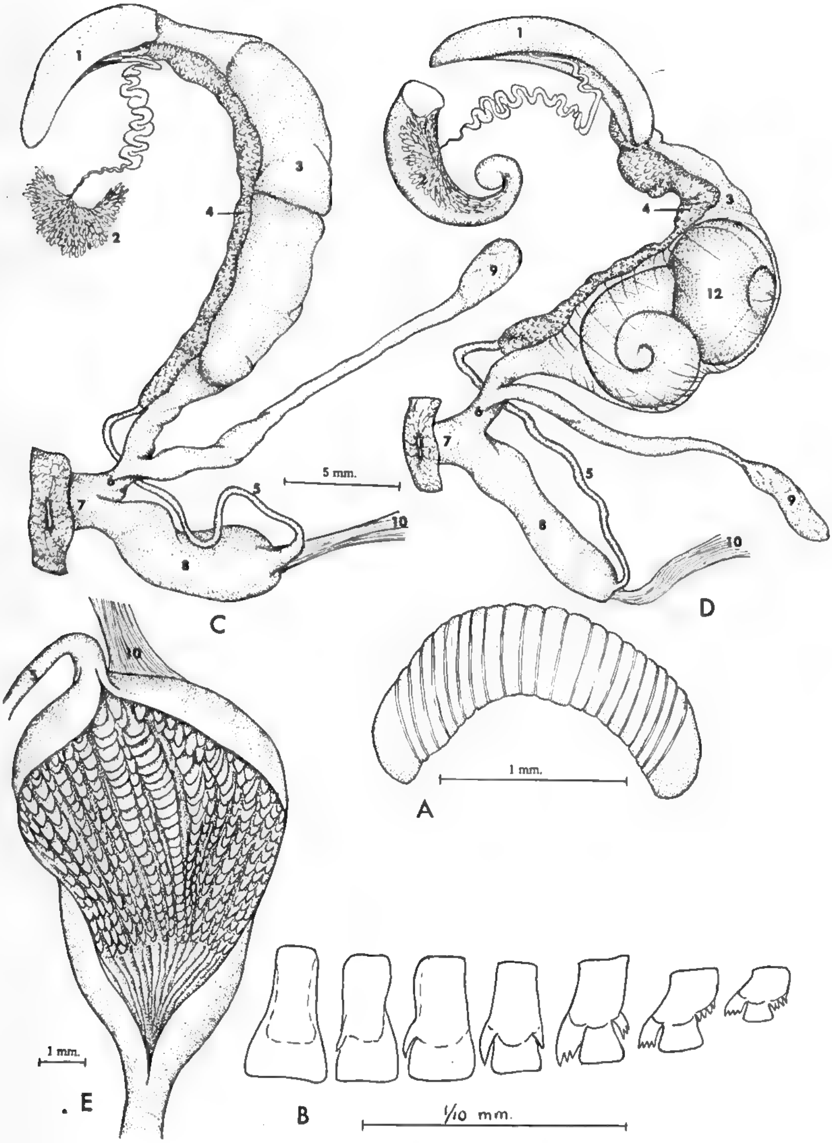


Fig. 8.

Megalacron klaarwateri (Rensch). A, jaw. B, radular teeth. C, complete reproductive system. D, reproductive system with two young in the uterus. E, dissected penis. (See figure 1 for labelling of the reproductive system.)

Head, foot, body, all a uniform light yellowish tan without any markings. Eye stalks dark brown. The jaw, denticles of the radula and the reproductive system are illustrated in text figure 8 (a-e). The jaw (a) is finely but definitely ribbed, and the denticles on the radula (b) are arranged in straight rows. Six specimens were dissected, of which three had two large, well-developed young in the uterus (c), the shells even showing the color pattern of the adult. In two specimens the uterus was divided into two distinct parts (d) and one had two eggs in the uterus. The interior of the penis (e) had numerous rows of fleshy pilasters which extended about three-quarters the length, the basal portion being thin walled.

Specimens examined: MANUS ISLAND: Tavi; Petaiya; Drabui; Malai (all AMNH and MCZ); Bundralis (ANSP); Lorengau (MCZ); Kwaliap, 9 mi. inland; Buyang, 8 mi. inland at 1000 ft.; Tingan, 6 mi. inland at 800 ft.; Pundran, 5 mi. inland (all BPBM).

Genus *RHYTIDOCONCHA* Rensch.

Rhytidoconcha Rensch, 1933, *Zool. Anzeiger,* 102:313 (type species, *Papuina inquirenda* Rensch, original designation).

Shells subglobose, flat white in color with one species *R. inquirenda* having minute black spots. Sculpture rather coarse with irregular incised lines and much broader and irregular raised areas.

Species in this genus are characterized by having the denticles on the radula arranged in nearly straight rows which are not offset with the rows above and below. The spermatheca with a short duct, elliptical in outline and only slightly greater in diameter than the spermathecal duct.

Rhytidoconcha inquirenda (Rensch).

Plate 10, fig. 16; Plate 11, fig. 7-9.

Papuina inquirenda Rensch, 1929, *Zool. Anzeiger,* 85:49, text fig. 1 (St. Matthias [Mussau], Bismarck Archipelago). [Holotype, Berlin Mus.; paratype, Mus. Comp. Zool. no. 83863.]

Description: Shell globose, reaching 12½ mm. in width, imperforate and sculptured. Color white with numerous irregular and very small black dots with much smaller white dots in the centre. The black dot is translucent and the central white one opaque. Whorls 3, convex and with a rounded periphery. Suture well defined and indented. Spire slightly elevated and produced at an angle of 90°. Aperture subcircular and cast at an angle of about 45° from the base. Parietal wall thinly glazed. Outer lip narrow, slightly reflected and with a slight restriction or depressed area just behind the lip. Columella short, rounded toward the base of the shell and flattened. Protoconch consisting of 1¼ whorls and sculptured with numerous, very fine spiral threads. Sculpture of the second whorl consisting of the same fine threads. The body whorl is sculptured with numerous, irregular, incised lines mainly in spiral arrangement. Periostracum yellowish and deciduous.

Height	Width	
10 mm.	12.5 mm.	Paratype.

Remarks: There are but two species known in this genus. This species differs materially from *R. confirmata* (Rensch) of Manus Island by being smaller, having a more circular aperture and in having the translucent black dots.

The anatomy of the reproductive system of *R. inquirenda* was figured by Rensch (1933, p. 314).

Specimens examined: MUSSAU: (MCZ); E. of Malakata (UMK).

Rhytidoconcha confirmata (Rensch).

Plate 10, fig. 15; text fig. 9.

Papuina (*Rhytidoconcha*) *inquirenda confirmata* Rensch, 1933, *Zool. Anzeiger,* 102:315 (Iriu, Manus Island, Bismarck Archipelago). [Holotype, Basel Mus.; paratype, Berlin Mus.]

Description: Shell subglobose, reaching 16½ mm. in width, imperforate and sculptured. Color a flat white. Whorls 4, convex and rounded at the periphery. Suture well defined and indented. Spire elevated and produced at an angle of about 85°. Aperture subcircular and cast at an

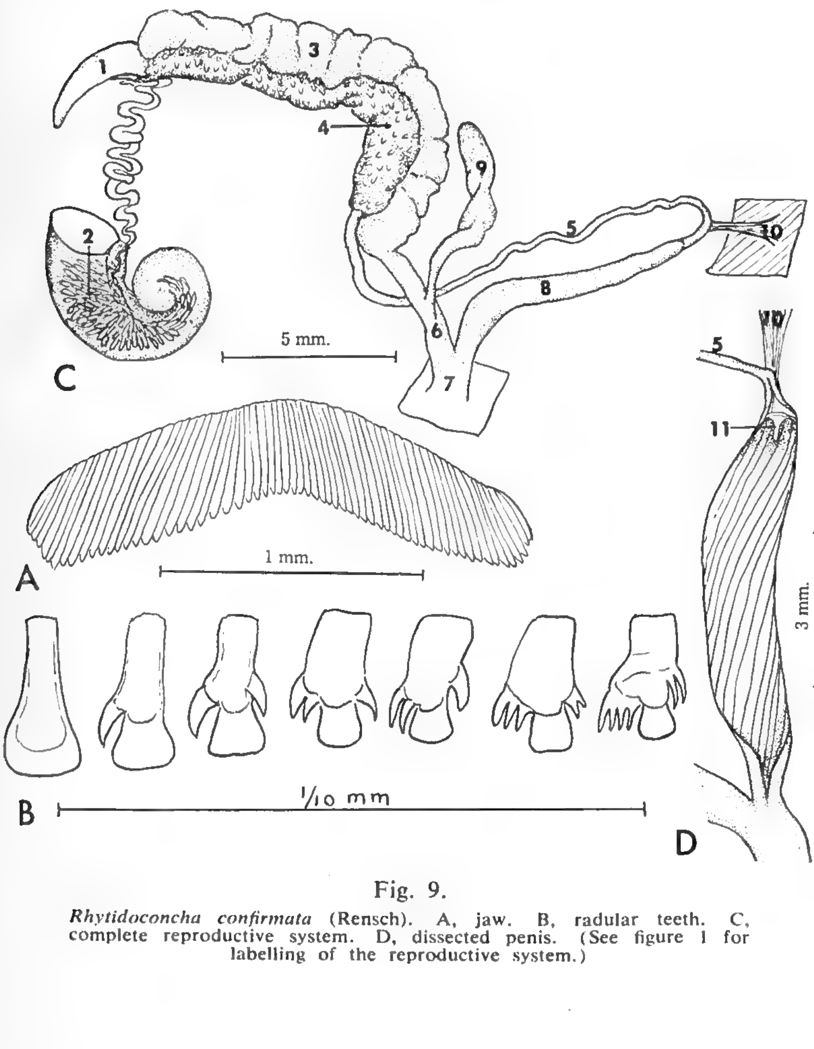


Fig. 9.

Rhytidoconcha confirmata (Rensch). A, jaw. B, radular teeth. C, complete reproductive system. D, dissected penis. (See figure 1 for labelling of the reproductive system.)

angle of 40° from the base. Parietal wall not glazed. Outer lip rather narrow, reflected and with a depression behind. Columella short, round toward the base of the shell and flattened. Protoconch consisting of a single whorl and sculptured with very fine spiral threads which continue over the next two whorls. Body whorl sculptured with numerous irregular, coarse, interlacing incised lines. In transmitted light the incised lines are translucent and the area between the lines are opaque, giving the shell an irregularly corrugated appearance. Periostracum yellowish and deciduous.

Height	Width		
16 mm.	16.5 mm.	Drabui Village,	Manus Island.
14 mm.	16 mm.	,,	,,
14 mm.	16.5 mm.	,,	,,
13.5 mm.	15 mm.	Malai Village,	,,
13.5 mm.	16.5 mm.	,,	,,
12 mm.	12.5 mm.	,,	,,

Remarks: See remarks under *R. inquirenda* Rensch.

The reproductive anatomy is shown in text figure 9. Five specimens were dissected. The spermatheca is long and oval in outline, only slightly greater in diameter than the short spermathecal duct. The penis is long and slender with a thin wall and low, weak pilasters, a small penis papilla and small epiphallus.

Specimens examined: MANUS ID.: Drabui; Lorengau; Malai; Tavi (AMNH; MCZ).

Fig. 1: *Megalacron lambei* (Pfeiffer). Admiralty Islands. Holotype, BM(NH) Cuming Colln. (nat. size).

Fig. 2-3: *Megalacron tabarensis anirensis* (Rensch). Anir Island, S.E. of New Ireland, Bismarck Archipelago. Holotype, SMF 7580 (nat. size).

Fig. 4: *Megalacron lambei vuatomensis* (Rensch). Vuatom Island, Neu Pommern Island [New Britain, Bismarck Archipelago]. Paratype, Basel Mus. 3945a (1.3 x).

Fig. 5-6: *Megalacron tabarensis mahurensis* (Rensch). Mahur Island, Lihir Group, Bismarck Archipelago. Holotype, SMF 7578 (nat. size).

Fig. 7: *Megalacron alfredi* (Cox). Solomon Islands. Holotype, Australian Mus. C62688 (1.5 x).

Fig. 8: *Papuina lambei matthiae* Boettger [=*Megalacron spadicea dunckeri* (Leschke)]. Small island near St. Matthias [Mussau Island, Bismarck Archipelago]. Lectotype, SMF 5939 (nat. size).

Fig. 9-10: *Megalacron novaegeorgiensis* (Cox). New Georgia, Solomon Islands [Admiralty Islands, Bismarck Archipelago]. Holotype, Australian Mus. C62676 (1.5 x).

Fig. 11: *Helix (Geotrochus) moseleyi* Smith [=*Megalacron novaegeorgiensis* (Cox)]. Wild Island, Admiralty Islands [about 5 miles N. of Moseley Point, Manus Island] Holotype, BM(NH) 84.6.12.580 (2 x).

Fig. 12: *Papuina phaeostoma raremaculata* Rolle [=*Megalacron phaeostoma* (v. Martens)]. Kung Island, near New Hanover, Bismarck Archipelago. Lectotype, SMF 8653 (nat. size).

Fig. 13: *Megalacron spadicea* (Fulton). Neu Mecklenburg [New Ireland], Bismarck Archipelago. Holotype, BM(NH) 1902.5.28.34 (nat. size).

Fig. 14-15: *Papuina phaeostoma fulgurata* Rolle [=*Megalacron phaeostoma* (v. Martens)]. Kung Island, near New Hanover, Bismarck Archipelago. Lectotype, SMF 8652 (nat. size).

Fig. 16-17: *Papuina phaeostoma densepicta* Rolle [=*Megalacron phaeostoma* (v. Martens)]. Kung Island, near New Hanover, Bismarck Archipelago. Lectotype, SMF 8654 (nat. size).

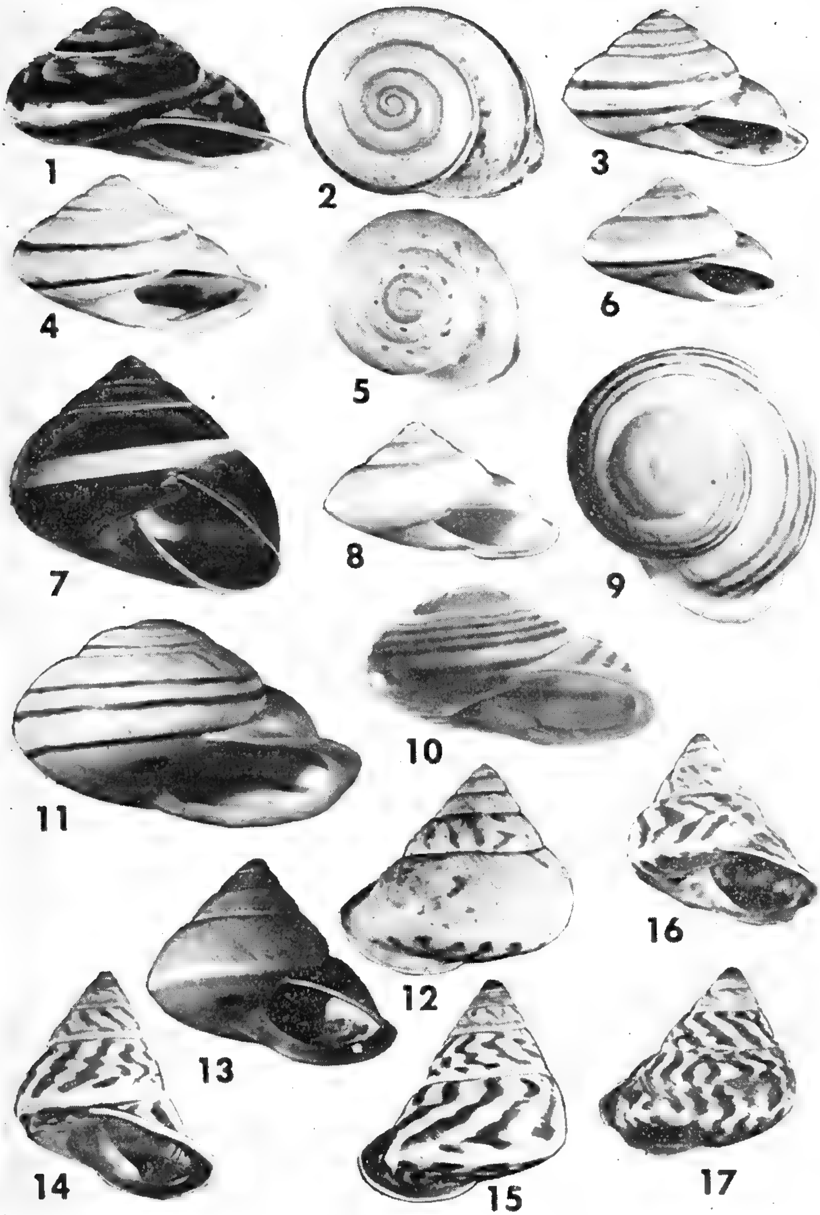


PLATE 8

Fig. 1: *Megalacron lambei novohibernica* (M. Smith). [Kavieng], New Ireland [Bismarck Archipelago]. Holotype, Florida State Mus. 12451 (1.2 x).

Fig. 2: *Megalacron tabarensis* (Rensch). Tabar Island, New Ireland, Bismarck Archipelago. Paratype, MCZ 59848 (1.2 x).

Fig. 3-4: *Megalacron tabarensis warrenae* Clench and Turner. Boang Island, Tanga Group, Bismarck Archipelago. Fig. 3, Holotype, AMNH 111300; fig. 4, Paratype, MCZ 181333 (1.2 x).

Fig. 5-6: *Megalacron spadicea dunckeri* (Leschke). Mussau Island, St. Matthias Group, Bismarck Archipelago (1.2 x).

Fig. 7: *Papuina humilis* Fulton [=*Megalacron spadicea* (Fulton)]. Nusa, Neu Mecklenburg [New Ireland], Bismarck Archipelago. Holotype, BM(NH) 1902.5.28.36 (1.4 x).

Fig. 8: *Megalacron juttingae* Clench and Turner. Kalili Bay, New Ireland, Bismarck Archipelago. Holotype, Univ. Mus. Kobenhavn, Denmark (1.2 x).

Fig. 9: *Megalacron coniformis* (Férussac). New Mecklenberg [New Ireland], Bismarck Archipelago. UM 76272 (1.2 x).

Fig. 10: *Megalacron bequaerti* Clench and Turner. New Ireland, Bismarck Archipelago. MCZ 39392 (1.1 x).

Fig. 11-12: *Megalacron phaeostoma* (v. Martens). Kung Island, New Hanover Island, Bismarck Archipelago. MCZ 157456 (1.1 x).

Fig. 13: *Megalacron phaeostoma mediensis* (Rensch). Medina, New Ireland, Bismarck Archipelago. Paratype, MCZ 156954 (1.2 x).

Fig. 14: *Papuina phaeostoma kandanensis* Rensch [=*Megalacron phaeostoma mediensis* (Rensch)]. Kandan, New Ireland, Bismarck Archipelago. Paratype, MCZ 59849 (1.2 x).

Fig. 15: *Papuina phaeostoma lamassongensis* Rensch [=*Megalacron phaeostoma mediensis* (Rensch)]. Fatmilak, New Ireland, Bismarck Archipelago. Paratype, MCZ 156951 (1.2 x).

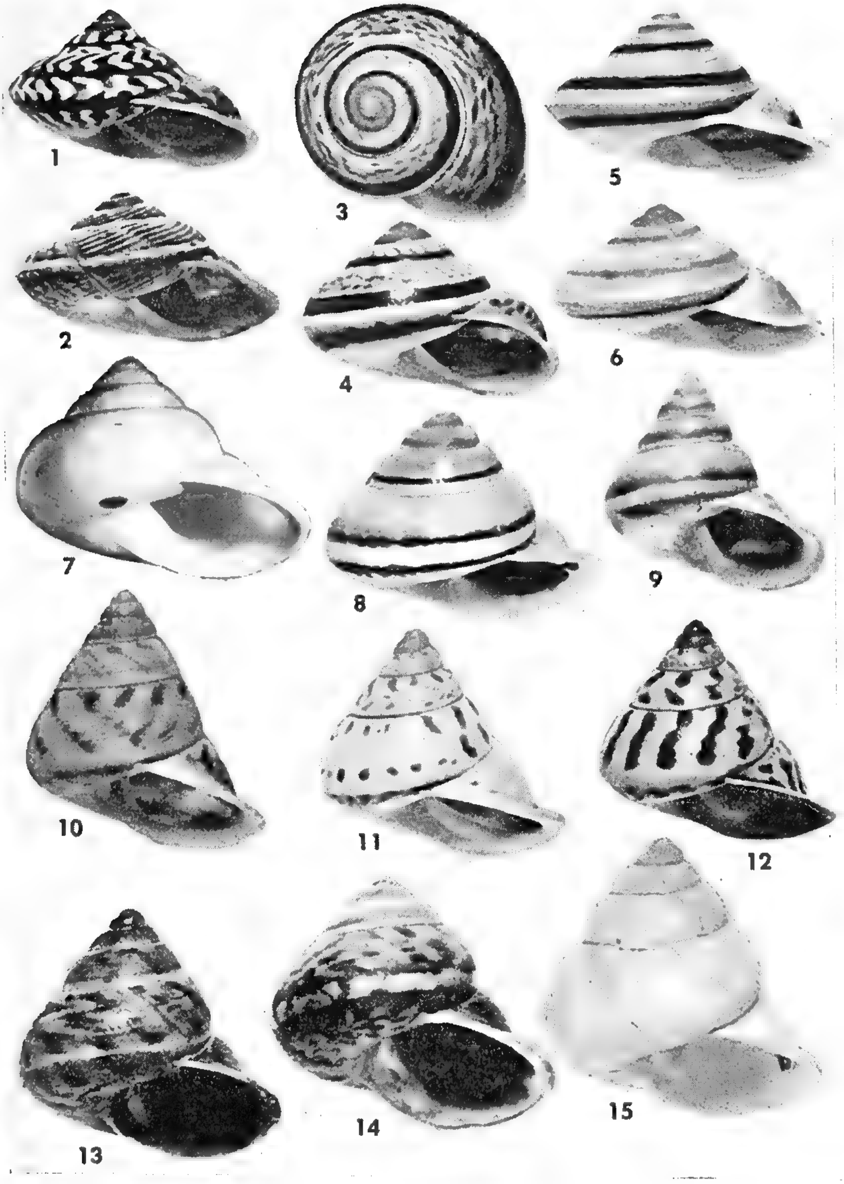


PLATE 9

Fig. 1-2: *Megalacron lufensis* (Thiele). Ninigo Group, Bismarck Archipelago. MCZ 181335 (1.7 x).

Fig. 3: *Megalacron periwonensis* (Dell). Near Periwon, Nissan Island, Bismarck Archipelago. Paratype, MCZ 190125 (1.3 x).

Fig. 4: *Megalacron novaegeorgiensis creta* (Rensch). Französischen Inseln [Viti Islands], N. of New Britain, Bismarck Archipelago. Paratype, MCZ 83856 (1.2 x).

Fig. 5: *Megalacron densestriata* (Fulton). Neu Mecklenburg [New Ireland], Bismarck Archipelago. Holotype, BM(NH) 1902.5.28.24 (1.3 x).

Fig. 6: *Helix barnaclei* E. A. Smith [=*Megalacron alfredi* (Cox)]. Hawaii, Sandwich Islands [Solomon Islands]. Lectotype, BM(NH) 77.7.14.1 (1.2 x).

Fig. 7: *Megalacron klaarwateri* (Rensch). Manus Island, Admiralty Islands. Holotype, Berlin Mus. (1.8 x).

Fig. 8-12: *Megalacron klaarwateri* (Rensch). Tavi Village, Manus Island, Admiralty Islands. Series to show variation in banding and color. MCZ 181370 (1.7 x).

Fig. 13: *Megalacron boyerii* (Fischer and Bernardi). Woodlark Id., New Guinea. MCZ 157313 (1.3 x).

Fig. 14: *Megalacron melanesia* Clench and Turner. Waterfall, Lorengau, Manus Id., Admiralty Islands. Holotype, UMK (1.3 x).

Fig. 15: *Rhytidoconcha confirmata* (Rensch). Iriu, Manus Island, Bismarck Archipelago. MCZ 181024 (1.6 x).

Fig. 16: *Rhytidoconcha inquirenda* (Rensch). St. Matthias [Mussau], Bismarck Archipelago. Paratype, MCZ 83863 (1.7 x).

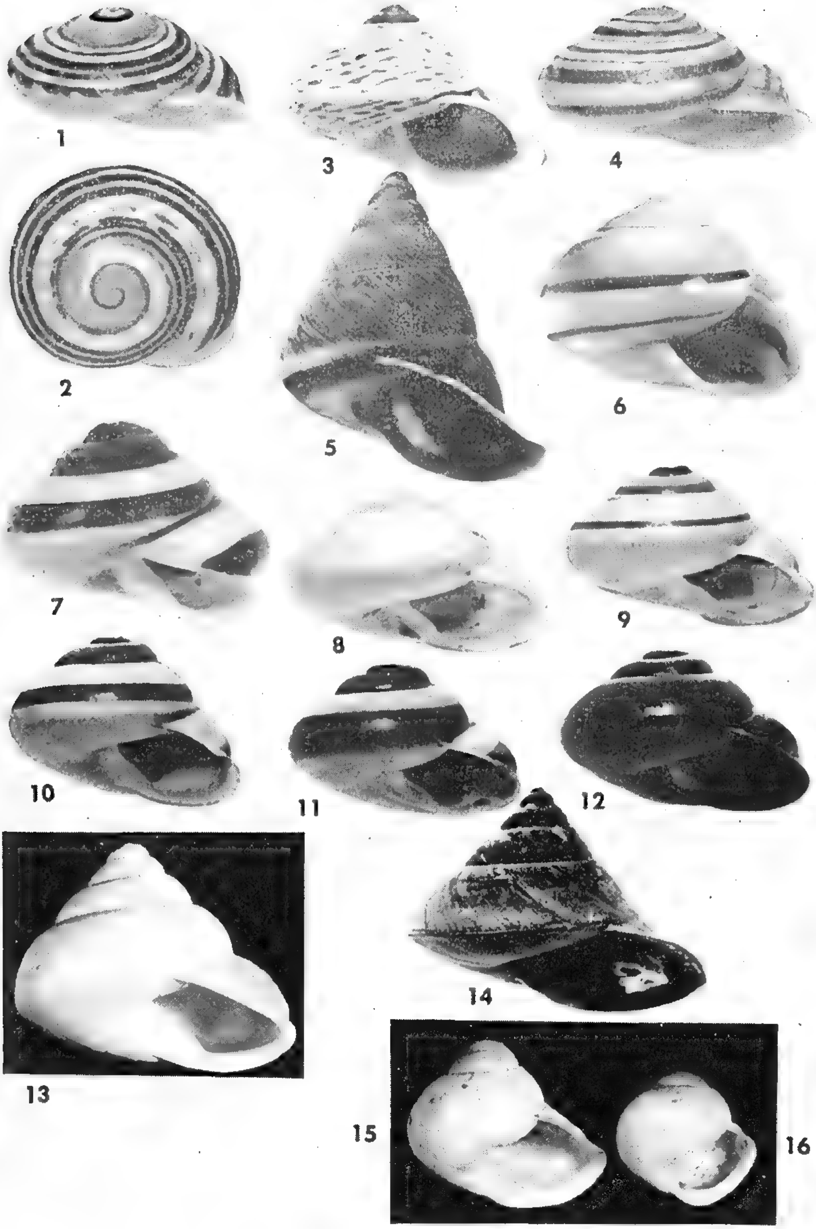


PLATE 10

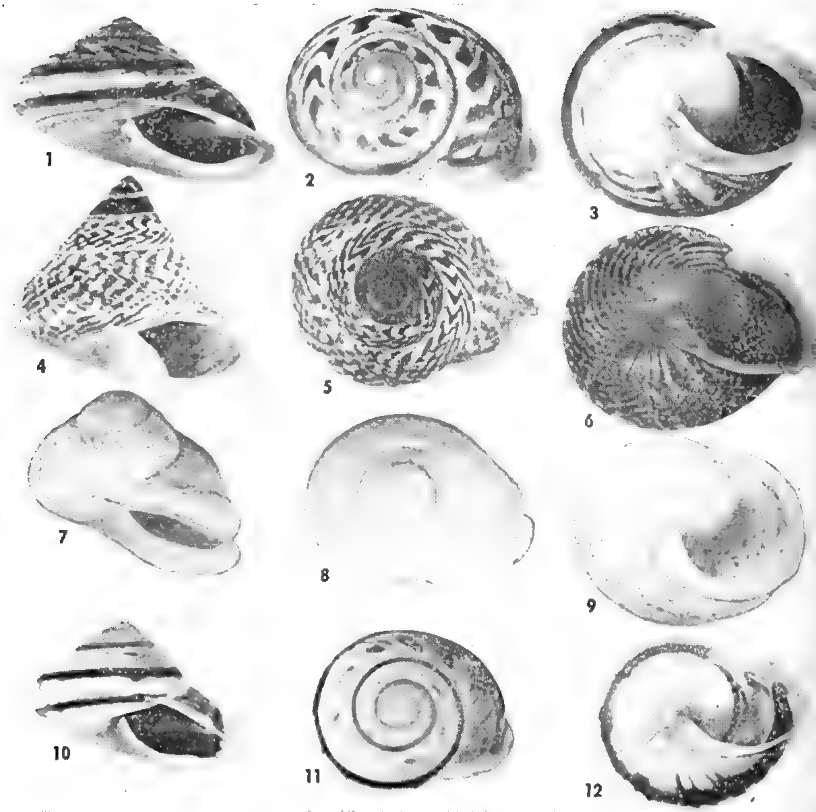


PLATE 11

Fig. 1-3: *Megalacron tabarensis lihirensis* (Rensch). Lihir Island, Lihir Group, Bismarck Archipelago. Holotype, Berlin Mus. (1.2 x).

Fig. 4-6: *Megalacron admiralitatis* (Rensch). Manus Island, Admiralty Islands. Holotype, Berlin Mus. (1.2 x).

Fig. 7-9: *Rhytidoconcha inquirenda* (Rensch). St. Matthias [Mussau Id.], Bismarck Archipelago. Holotype, Berlin Mus. (1.8 x).

Fig. 10-12: *Megalacron lambei vuatomensis* (Rensch). Vuatom Island, Neu Pommern [New Britain], Bismarck Archipelago. Holotype, Berlin Mus. (1.1 x).

REFERENCES

CLENCH, W. J., and R. D. TURNER, 1962. Monographs of the Genera *Papustyla, Forcartia* and *Meliobba* (Papuininae: Camaenidae). *J. Malac. Soc. Aust.,* 6:3-33.

JUTTING, T. v.B., 1933. Non Marine Mollusca from Dutch North New Guinea including an annotated list of the species of *Papuina. Nova Guinea,* 17:1-80.

PILSBRY, H. A., 1891. *Manual of Conchology,* (2), 7:3-81.

RENSCH, I., 1933. Diagnosen neuer *Papuina*-Arten. *Zool. Anz.,* 102:313-319.

RENSCH, I., 1934. Systematische und tiergeographische Untersuchungen über die Landschneckenfauna des Bismarck-Archipels I. *Arch. Naturgesch. N.F.,* 3:445-488.

ZILCH, A., 1960. In Schindewolf, *Handbuch der Paläozoologie,* 6, (2): 619-621.

ZILCH, A., 1960. Die Typen und Typoide des Natur-Museums Senckenberg. *Arch. Molluskenk.,* 89:193-202.

INSTRUCTIONS TO AUTHORS

1. It is the responsibility of authors to prepare papers in a form suitable for publication, and they should consult a current issue in order to familiarize themselves with the practices of the *Journal,* with particular reference to the use of bold-face or italic type, headings, etc.
2. No paper shall be published unless approved by the Editor and the Committee and any paper may be submitted to one or more referees before acceptance.
3. Upon acceptance for publication, the paper, including plates, maps, diagrams and photographs, and all copyrights thereof become the property of the Society.
4. Papers should be in double-spaced type-script on one side of the paper only with 1½" margins. The author's name should appear underneath the title with a footnote indicating the address of the institution (if any) to which he belongs and any necessary acknowledgments. A summary of longer papers should be included. The original type-script and one carbon copy should be submitted.
5. As a standard for spelling, the *Journal* uses the *Concise Oxford Dictionary of Current English* (1951, 4th ed., Clarendon Press, Oxford).
6. References should be cited in the text by year of publication, e.g., Leloup (1961) or, if there are several publications by the same author in the same year, Leloup (1961a, 1961b) and they should

be arranged at the end of the article in alphabetical order of the authors' names in the following form:

> Leloup, E., 1961. Species of the Genus *Liolophura* Pilsbry, 1893 (Mollusca, Polyplacophora). *J. Malac. Soc. Aust.*, 5: 39-49, pl. 3, text figs. 1-5.

References to books should give the year of publication, the number of the edition, the name of the publisher and the city of publication. Abbreviations of periodicals should conform with those used in *A World List of Scientific Periodicals* (1952, 3rd ed., Butterworth, London), except that capital initial letters are used throughout, thus "*J. Malac. Soc. Aust.*"

7. Symbols and abbreviations should conform with those recommended in the Royal Society's publication, *General Notes on the Preparation of Scientific Papers* (1950, Cambridge University Press, London), e.g., all names which are to be printed in italics (such as generic and specific names) must be underlined in the type-scripts.

8. When possible, a proof will be supplied to the author for correction. In general, corrections should not include changes from the original text. Such changes may be charged to the author if the Editor deems them to be excessive.

9. A reasonable number of text figures and plates will be reproduced at no cost to the author. Reproduction on special art paper or in colour must, as a rule, be paid for by the author. Full plate size is $6\frac{1}{2}''$ by $4''$ and the maximum width for text figures is $4''$.

10. Tables should carry a short heading describing the nature of the facts assembled. Both figures and plates, as well as graphs and tables, should be fully comprehensible without reference to the text if possible.

11. New Taxonomic units of any kind shall be published only if the description is clearly set out and conforms with the requirements of the *International Code of Zoological Nomenclature* (1961, International Trust for Zoological Nomenclature, London) as amended.

12. Descriptions of new species or subspecies should not be submitted unless arrangements have been made by the author for depositing the holotype with a recognised public Museum, and Museum numbers of the type specimens should be included in the paper. Type localities should be defined as accurately as possible.

13. The Editor reserves the right to make literary amendments, but authors will see any such amendments before publication.

14. Reprints are obtainable by previous arrangement with the Editor. Twenty-five copies are provided free and additional copies will be charged to authors.

THE MALACOLOGICAL SOCIETY OF AUSTRALIA

1965

Patrons:

R. TUCKER ABBOTT, Ph.D.
JOYCE ALLAN, F.R.Z.S.
BERNARD C. COTTON, F.R.Z.S.
E. ALISON KAY, Ph.D.

Honorary Members:

A. W. B. POWELL, D.Sc.
RUDOLF BRUNNSCHWEILER, Ph.D.
EDMUND D. GILL, B.A., B.D., F.G.S.

Honorary Life Member:

Mrs. THELMA HARTLEY

President:

T. A. GARRARD

Hon. Secretary-Treasurer:

DONALD F. McMICHAEL

Hon. Editor:

DONALD F. McMICHAEL

Printed by K. A. Wood Pty. Ltd., 61-63 Sussex Street, Sydney, N.S.W. Registered in Australia for transmission by post as a book.

Published annually by the Malacological Society of Australia and obtainable from the Hon. Editor, C/o The Australian Museum, College Street, Sydney, N.S.W. Price £1/-/- or $2.00 Australian, or $2.25 U.S. Currency, or 16/- Sterling. Special rates for complete sets.

VARIATION IN THE *ZOILA FRIENDI* (GRAY) SPECIES COMPLEX (GASTROPODA: CYPRAEIDAE) IN SOUTH-WESTERN AUSTRALIA

By BARRY R. WILSON* and RAY SUMMERS†

Pls. 1-4, text figs. 1-4.

Extreme intra-specific morphological variation is well known among terrestrial and freshwater mollusks (*e.g.*, Welch 1938, Diver 1939, Cain and Sheppard 1950, Leloup 1950, 1953) and several examples of such variation in marine species have been described (*e.g.*, McMichael 1959, Kincaid 1957). Griffiths (1962a) and Orr (1959) have shown that variation of this kind occurs in some species of the family Cypraeidae.

In this paper data are presented illustrating variation of several morphological characters of the *Zoila friendi* (Gray, 1831) species complex in South-western Australia. Representatives of the group are found along the continental shelf from Shark Bay on the mid-west coast of Western Australia to South Australia. Over much of this range they inhabit the full width of the continental shelf, but no specimens appear to have been collected from the outer part of the shelf in South Australia.

Within this unusually variable species complex previous authors have recognized two species each containing two subspecies (= races). A brief outline of this arrangement, and the previously stated diagnoses, is given below. This is followed by a consideration of the variation of each of the shell characters used by other authors to diagnose the "species" and "subspecies", plus our data on animal colour, radula and habitat. The value of these variants as systematic characters is discussed. It is shown that most of the shell characters previously used as diagnostic are not satisfactory taxonomic criteria. The taxonomy of the group is revised.

We use the generic name *Zoila*, with hesitations in view of the conclusions reached by Kay (1960). The anatomy of *Z. friendi* will be described and the problem of generic relationship will be discussed in a later paper.

PREVIOUS NOMENCLATURE

Zoila friendi friendi (Gray, 1831).

Diagnosis by previous authors: This western "subspecies" has been characterized by an elongate shell with elevated spire and upturned extremities (*i.e.*, produced sides of the anterior and posterior channels). The base of the shell is uniformly dark brown, the colour extending on to the sides from the base. The primary colour of the dorsum is pale cream with four radial bands of ash-blue blocks. This is partially obscured by varying degrees of irregular brown blotching. Some shells are almost uniformly dark brown on the dorsum as well as on the base and sides, *i.e.*, the underlying cream and ash-blue bands are completely covered.

Characteristically the teeth on the columellar side are reduced to several relatively strong anterior teeth and a few crenulations. There are no teeth or crenulations on the posterior half of the columella. The columellar teeth do not extend into the fossula. Schilder and Schilder (1938-39) give the formula (73 [mean length] · 54 [mean width: length] · 18 [mean number labial teeth] · 15 [mean number columellar teeth]) for this race, and the range as "Swan River to Ellenbrook [approximately 20 miles south of Cape Naturaliste]".

* Curator of Molluscs, Western Australian Museum, Perth.
† P.O. Box 124, Petulama, California.

Zoila friendi vercoi (Schilder, 1930).

Diagnosis by previous authors: Verco (1918) described three wide specimens of *Z. friendi* from Esperance on the south coast of Western Australia. Schilder (1930) repeated Verco's description and gave them the racial name *vercoi*, designating Verco's specimens as types. Schilder did not personally examine these specimens.

A translation of Schilder's description is here given:

"*Zoila friendii vercoi* nov. subsp., when compared with *friendii* Gray *s. str.* (south west coast), is longer (81-94 mm. instead of 65-88, extreme range 42-88 mm.), broader (BL. [*i.e.*, Width: Length] = 56-62 instead of 52-55)[17] and higher (HL. [*i.e.*, Height: Length] = 43-49 instead of 42-43); it differs from *thersites* Gaskoin (mid-south coast of Australia) in the base which is continuously black-brown up to the aperture. Furthermore, *thersites* is usually smaller (71-75, extreme range 65-83 mm.) and still broader (BL. = 66-69) and higher (HL. = 52-55)."

"([17] For the relative breadth and height index only the 50% limits are given, for absolute length the extreme range is given in addition.)"

In a later paper Schilder and Schilder (1938-39) added ". . . besides. the aperture of *vercoi* is wider, and the spire is said to be less projecting than in *friendii* but more than in *thersites*" but noted that the race needed confirmation. They give the formula (86.60.?.?).

Zoila thersites thersites (Gaskoin, 1849).

Diagnosis by previous authors: Shells from Port Lincoln to Beachport, South Australia, are relatively wider than those from Esperance, and were supposed to have an even shorter spire and less turned up extremities. The colour pattern of the dorsum and sides as in *Z. friendi*, but the dark brown on the base does not extend all the way to the edges of the aperture. Schilder and Schilder (1938-39) give the formula (74.68.17.14) and the range Port Lincoln to Beachport, eastern South Australia.

The systematic status of these South Australian populations has always been controversial. Verco (1918) placed them as a race of *Z. friendi*. Schilder and Schilder (1938-39) used this interpretation but in a more recent paper (1961) follow most recent authors and list *thersites* and *friendi* as distinct species.

Zoila thersites contraria (Iredale, 1935).

Diagnosis by previous authors: Verco (1912) recorded pale *Z. thersites* dredged from 72 to 100 fathoms in the western part of the Great Australian Bight. Iredale (1935) recognized these as a distinct subspecies but did not give adequate diagnosis. He gave no reasons for regarding these shells as pale forms of *Z. thersites* rather than of *Z. friendi*. Presumably he was influenced by the fact that the deep water pale shells are as wide or wider than *Z. thersites*. They differ from both "species" in the general loss of dark shell pigment. Usually remnants of the colour pattern remain as pale orange marks, but in some specimens the shell is entirely white or off-white. Schilder and Schilder (1938-39) give the formula (70.68.18.13) for this race. Griffiths (1962b) recognizes *Z. contraria* as a full species.

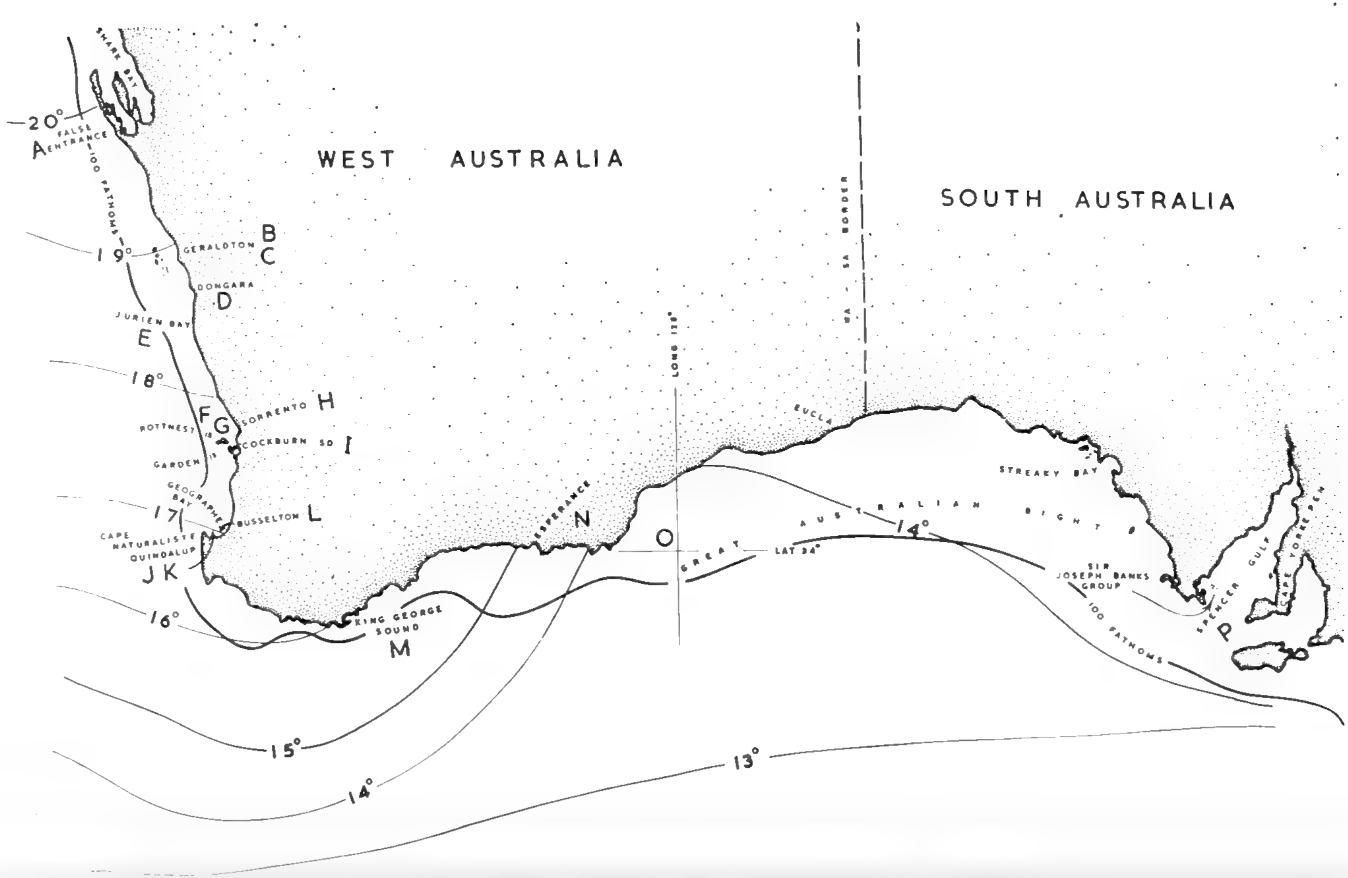
In addition to the four "subspecies" listed above *Z. marginata* Gaskoin 1848 and *Z. venusta* Sowerby 1859 (= *Z. episema* Iredale 1939) have at times been placed as subspecies or synonyms of either *Z. friendi* or *Z. thersites*. These are now generally accepted as quite distinct species, an opinion with which we entirely agree, and we do not propose to consider them in the present paper.

HABITAT AND DEVELOPMENT

In shallow water in Western Australia *Z. friendi* occurs among meadows of the sea-grass *Posidonia*. They may be found perched up on *Pinna* shells, sponges, sponge covered rocks or on jetty piles. Mr. Paul Trenberth (1962 and personal communication) takes *thersites* on sponges in 2 to 4 fathoms in the vicinity of the Sir Joseph Banks Group, Yorke Peninsula, South Australia.

The *Posidonia* meadows do not extend far below 10 fathoms off the Western Australian coast. Little is known about the habitat of *Z. friendi* below this depth although a close association with sponges seems certain. One specimen was collected by a diver in 17 fathoms off Rottnest Island from a sponge on limestone rock. Other deep water specimens have been taken from "crayfish" pots (with hermit crabs) or dredged.

Trenberth (1962) records egg-sitting females of *thersites* in South Australia in October to January. In Cockburn Sound during the early summer (October to January) females may be found "sitting" on eggs. The egg clutch is a compact mass 5 to 6 cm. in diameter with 4 to 5 layers of egg capsules at the centre. There are between one and two hundred capsules per clutch, each capsule being about 2.5 mm. in diameter. The egg masses are orange and are generally laid in depressions in sponges or dead bivalve shells. Mrs. S. Slack-Smith advises us that an egg mass collected in Cockburn Sound in late October, 1964, contained tiny transparent shells of about one whorl. The females sit over their clutch completely covering it and will return to this position if disturbed. Whether the females remains there until the larvae hatch is uncertain. Further study is also required before it can be determined whether these cypraeids have a short planktonic larval stage, or whether development is direct. Ostergaard (1950) showed that Hawaiian cowries he studied have short pelagic stages. Griffiths (1962a) concluded that development is direct in species of the southern Australian group assigned to the genus *Notocypraea*.



Text fig. 1. Map of the area showing sample localities (see table 1), the 100 fathom contour and surface water isotherms

VARIATION OF SYSTEMATIC CHARACTERS WITHIN THE *Z. FRIENDI* COMPLEX

(1) *Shell dimensions and proportions*: Shells collected near limestone reefs in open ocean water off Sorrento Beach, approximately 20 miles north of Fremantle, are consistently larger than shells from Cockburn Sound about 25 miles further south where the environment is more sheltered and almost land locked by Garden and Carnac Islands. We have seven specimens from Sorrento ranging from 85 to 99 mm. in length (mean 91 mm.). The mean of our Cockburn Sound sample is 72 mm. and the largest shell 83.8 mm. A similar situation is seen in Geographe Bay, where adult shells collected from a small, shallow water population cut off from the open ocean by a wide, shallow sand bar, are consistently very small (mean length 50.8 mm.) while shells from outside the bar in more open water are much larger (mean length 75.5 mm.).

Such inter-locality variation in overall shell size appears to be common throughout the range of the species complex and is almost certainly eco-phenotypic. Total length is thus a most unsuitable systematic character. It is significant that in both instances described above there is no significant difference in the relative width:length proportions of the shells in our samples from adjacent populations, despite the large differences in overall size.

Relative width is the main character that has been used to separate the four races. Verco (1918:147) stated that there is an "uninterrupted gradation" in the increase in relative width from Fremantle to South Australia. Our data based on much larger series confirms this for shallow water populations in Cockburn Sound, Geographe Bay, Esperance and South Australia. The ranges in relative width of all four major samples overlap considerably and there is no apparent sudden change at any point. This character seems to be purely clinal. However, the rate of increase in relative width is not constant over the whole length of the cline. The most rapid increase takes place down the west coast southwards from Cockburn Sound. Eastwards from Cape Leeuwin the rate of increase is much less. Plotting relative width (W:L) against distance, the means fall in a curve rather than a straight line (fig. 2).

Specimens from deeper water do not follow this trend for they invariably have a greater relative width than shells from adjacent shallower water, *i.e.*, there is also clinal increase in relative width with increasing depth. The mean W:L ratio of our Cockburn Sound sample is 0.521. One specimen from 17 fathoms off Rottnest Island has a W:L ratio of 0.606, and another (a pale shell) from "80-100 fathoms between Fremantle and Geraldton" has a ratio of 0.636. Other specimens from deep water north of Fremantle show the same trend (table 1).

An increase in relative width with increasing depth is also supported by data from the south coast. The mean W:L ratio of our small King George Sound sample is 0.665 and falls well above the mean curve for shallow water shells. Two of the seven shells in this sample were trawled in 25 fathoms. The remaining specimens were collected on the beach at Frenchman's Bay near the mouth of King George Sound and the depth from which they originally came is unknown. However, it is reasonable to suspect that they came from moderately deep water as the coast line at this locality shelves steeply into 17 fathoms or more. The mean W:L of the sample of the pale shells ("*contraria*") from 60-100 fathoms in the western part of the Great Australian Bight also falls well above the mean curve for the shallow water shells in that region.

In fig. 2, both W:L ratio and winter surface water temperature are

plotted against distance along the coast. The resulting curves are similar which suggest that water temperature may be the environmental factor producing the clinal increase in relative width. Unfortunately hydrological data are poor for this region, but it is probable that there is a similar decrease in bottom water temperature across the continental shelf from the coastal shallows down to the edge of the continental slope.

Disregarding other characters, these data could be interpreted as demonstrating that all the shells belong to the one species in which there is clinal increase in relative width in two planes: horizontally from north to south and east, and vertically from the coast line down to the outer edge of the continental shelf. According to this interpretation the same cline operates along all contour levels around the shelf, but with the deeper levels "in advance" of the inshore shallow water cline. This idea is represented diagrammatically in fig. 2 (inset).

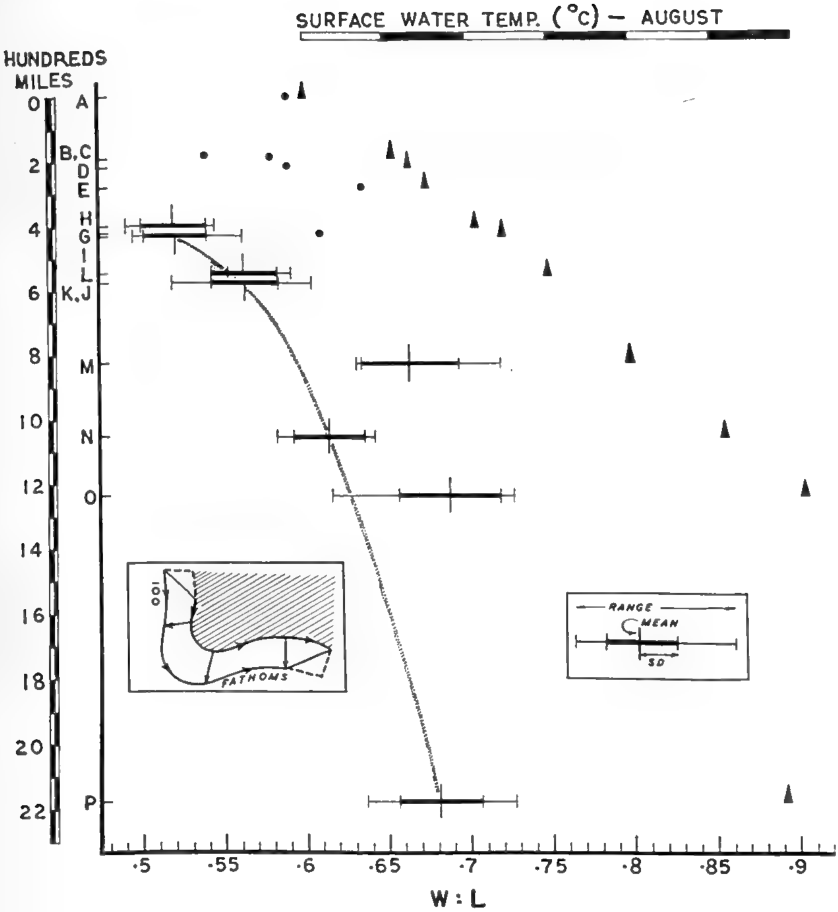
Our interpretation gains indirect support from the coefficients of variation calculated for all samples (table 1). The King George Sound and Great Australian Bight samples, both heterogeneous in respect to depth of collection, have a significantly higher variability than the four samples from shallow water which are comparatively homogeneous in this respect. If relative width increases with increasing depth such variability would be expected in samples taken from a wide range of depths.

Relative width is thus an unsuitable criterion for separating species or subspecies in this complex, since its variation appears to be continuous with no evidence of any sudden change at any point to indicate regions of restricted gene flow. Use of this character would be impossible in any case without knowledge of locality and depth because of the overlap in statistical range. The mean of the King George Sound sample is less than one standard deviation from the mean of the South Australian sample. One specimen from King George Sound, recently examined by Schilder and identified as *Z. friendi vercoi* (West Australian Museum regn. no. N1996), has a W:L ratio of 0.702 compared with 0.681, the mean of the South Australian sample.

(2) *Spire position and height*: In shells from the Fremantle area and northwards the spire invariably lies to the left of the posterior channel. This is exceptionally pronounced in specimens from Sorrento Beach. In most Geographe Bay and King George Sound shells the spire is similarly positioned, but in an occasional specimen the spire apex falls within the posterior channel (*e.g.*, pl. 1, fig. g). A little under 50% of the Esperance specimens have the spire apex lying to the left of the posterior channel: in the remainder it lies within, and this appears to be the invariable rule for South Australian shells.

There is therefore a progressive shift in the position of the spire apex in relation to the posterior channel, from north-western populations to south-eastern populations. This shift appears to be related to relative width, as those specimens from intermediate localities in which the spire apex falls within the posterior channel are invariably the widest specimens in the samples. Generally the wider and more gibbous the shell the more the aperture is curved and the posterior channel deflected to the left to encompass the spire apex.

We have measured spire height diagonally from the most dorsal point of the last suture to the apex and expressed it as a percentage of aperture length (*i.e.*, distance between inner edges of anterior and posterior channels). The results are graphed in text fig. 3a. It is clear that this character is also clinal and is probably directly related to relative width.



Text fig. 2. Relative width and mean surface water temperature (August) plotted against distance in miles from the most northern locality (Shark Bay), showing clinal increase in relative width from north to southeast of samples from shallow water (*i.e.*, samples H, I, L, K, J, N, P) and the corresponding decrease in surface water temperature. Samples from deeper water (*i.e.*, samples A, B, C, D, E, G, M, O) fall above the curve drawn between means of shallow water samples.

Inset illustrates the known distribution of the species on the continental shelf and the directions of the clinal increase in relative width (*i.e.*, horizontal and vertical).

TABLE 1

Locality	Sample code	Depth in fathoms	Total sample number	Register numbers of specimens in museum collections
False Entrance	A	25	1	WAM: 67-62
Off Geraldton	B-C	20-25	2	WAM: 8/9-62
Off Dongara	D	32	1	WAM: 7-63
"Between Fremantle and Geraldton"	E	80-100	1	WAM: 4999
20 miles NW Rottnest Id.	F	85-110	fragments	WAM: 30-63
1 mile N Bathurst Light, Rottnest Id.	G	17	1	WAM: 68-62
Sorrento	H	2-3	7	
Parmelia Bank, Cockburn Sound	I	1-4		WAM: 35/36-62; 10/12-63
Geographe Bay—off Quindalup	J	2-8	26	WAM: 38/54-62; 13/23-63
Geographe Bay—inside sand bar, Quindalup	K	0-1	16	WAM: 1-62; 55-62; 24-63; N2465
Geographe Bay—Busselton jetty	L	2-3	10	WAM: 25/28-63
King George Sound	M	?	6	
Esperance	N	2-4	9	WAM: 29-63
Western part of Great Australian Bight	O	70-100	28	WAM: N1996; 57/58-62
			21	WAM: 69/79-63; 37-62; 56-62
Spencer Gulf, South Australia	P	1-4	26	WAM: 3-62 NMV: F12900; F22860(2); F20883(2); F2508; F22863 AM: C35580; E3839; E3848 WAM: 130/131-45; 59/61-62 NMV: F1375; F17708(9); F22864(4); F22861; F16468; F2334(3); F22862(2)

TABLE 1. *Material examined.* Localities are indicated on text fig. 1 by sample code letters. Specimens examined in private collections are included in the total sample number (and were used in calculations), but the register numbers of only those specimens permanently lodged in museum collections are given. WAM = Western Australian Museum [Perth]; NMV = National Museum of Victoria [Melbourne]; AM = Australian Museum [Sydney].

(3) *Aperture width*: Verco (1918: 147) noted that: "The width of the aperture is not diagnostic. This is as narrow in the extreme western form as in the extreme eastern, while in the Esperance specimens it is wider."

Our measure was taken from the interstices between the labial teeth to the columellar callus, at the point where the shell was widest, and expressed as a percentage of total shell width. Relative aperture width is greatest in the King George Sound sample and decreases progressively in samples from the north and east of this (text fig. 3b). This progressive decrease may be coincidental, or it may be interpreted as clinal decrease in either direction from a central point. In the former case aperture width would be diagnostic of local populations only and have no systematic significance. Neither could this character be used as a systematic criterion if it varies clinally. In any case, the mean relative aperture width of our sample from Geographe Bay is greater than that of the Esperance sample. Clearly the use of this character to diagnose Esperance shells as a distinct subspecies is untenable.

(4) *Extremities*: One of the most striking features of west coast *Z. friendi* is the produced and turned up sides of the posterior and anterior channels. This is frequently used as a diagnostic character of this western "subspecies" (*e.g.*, Allan, 1956). Our measure was aperture length subtracted from total length, as a percentage of total length. Only fully mature shells were used as this is an adult characteristic. Text fig. 3c shows that the statistical ranges of all samples overlap and there is no apparent pattern of variation. The means of the Esperance and Sorrento samples are both significantly greater than the mean of the Cockburn Sound sample. Use of this character to separate west coast populations from southern populations is erroneous.

(5) *Dentition*: The "reduced number" of labial teeth have been calculated using Schilder's formula (Schilder and Schilder, 1938-39). There is no significant difference between samples from Cockburn Sound, Sorrento, outer Geographe Bay, King George Sound, Esperance, Great Australian Bight and South Australia. In every case the average reduced number is about 17. (The Schilders give 17 for *Z. friendi friendi* and *Z. thersites contraria*, and 18 for *Z. thersites*.) The sample of dwarf shells from inside the sand bank in Geographe Bay has an average reduced number of 15. This may be interpreted as a local variant.

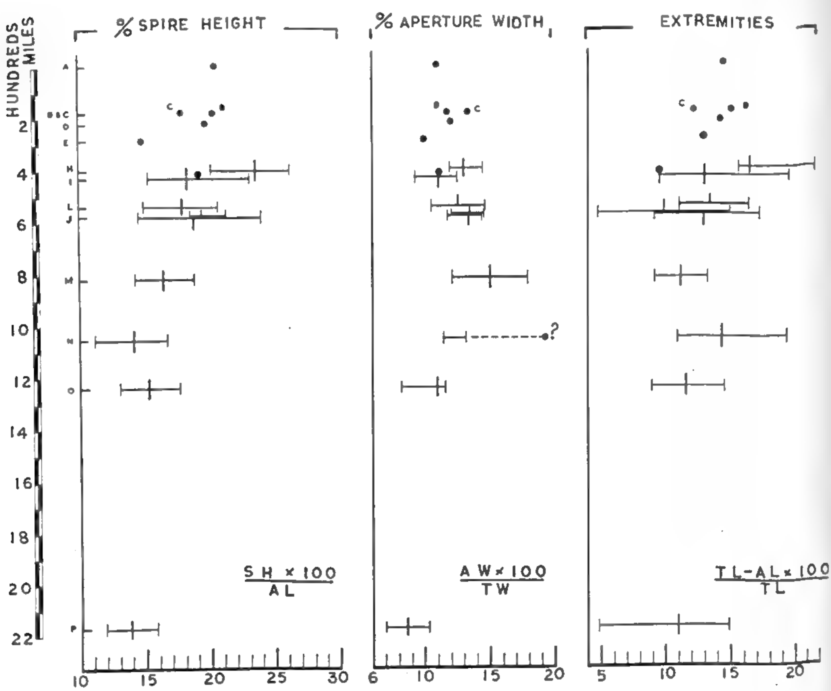
The columellar teeth are variable and difficult to count accurately and consistently. The first 4 to 8 teeth at the anterior end are usually strong, but never extend down on to the fossula. Behind these the columellar teeth rapidly become weak and reduced to mere crenulations. In shells from Cockburn Sound, Sorrento, Geographe Bay, King George Sound, Esperance and the Great Australian Bight there is rarely any sign of crenulations on the posterior half of the columella. However, in South Australian shells there are frequently 2 to 4 such crenulations at the posterior end. Sometimes these form relatively strong teeth. In occasional South Australian shells there are faint teeth all along the columella besides the usual 4 to 6 strong anterior teeth.

The four specimens from deeper water northwards from Fremantle all have faint teeth all along the columella, in addition to the usual few strong anterior teeth. This is particularly pronounced in the specimen from 20-30 fathoms off False Entrance in which there are 14 strong anterior teeth in a total of 31 (30 labial teeth). The tendency to retain the full complement of columellar teeth is therefore a feature of shells from the extreme limits of the species' geographic range.

TABLE 2. WIDTH: LENGTH STATISTICS FOR MAJOR SAMPLES.

Locality	Mean	SD	V	N
Sorrento (H)	0.519	0.0178	3.43	7
Cockburn Sound (I)	0.021	0.0188	3.61	26
Geographe Bay (J + K + L)	0.565	0.0197	5.09	32
King George Sound (M)	0.665	0.0339	3.38	7
Esperance (N)	0.611	0.0208	4.63	28
Great Australian Bight (O)	0.700	0.0324	3.64	18
Spencer Gulf (P)	0.681	0.0248	3.43	26

Mean = sample mean
SD = one standard deviation
V = variance
N = sample number



(a) (b) (c)

In all samples there is variation in the thickness and strength of both the labial and columellar teeth. In the Esperance sample a number of specimens have quite fine teeth, *i.e.*, this population shows more variability in this respect than other populations sampled (pl. 2, cf. figs. f, g).

(6) *Radula*: One of us (BRW) has examined series of radulae of animals from Sorrento (2), Cockburn Sound (20), Geographe Bay (6), Esperance (10) and the Sir Joseph Banks Group, St. Vincent Gulf, South Australia (15).

The radula is typical of Cypraeinae in bearing 7 tricuspid teeth per row with 80 to 150 rows. The median tooth is slightly wider than it is high with one prominent medial cusp bordered by a smaller cusp on either side. An internal dumb-bell-shaped bract extending across the base of the tooth stains more densely (chlorazol black) than the remainder of the tooth and bears a pair of small denticles, one in each lower corner. A prominent semi-circular bract, which does not take up the stain, projects downward from the base of the medial tooth. This latter element appears to be the structure Kay (1960) calls the "sub-tending bract".

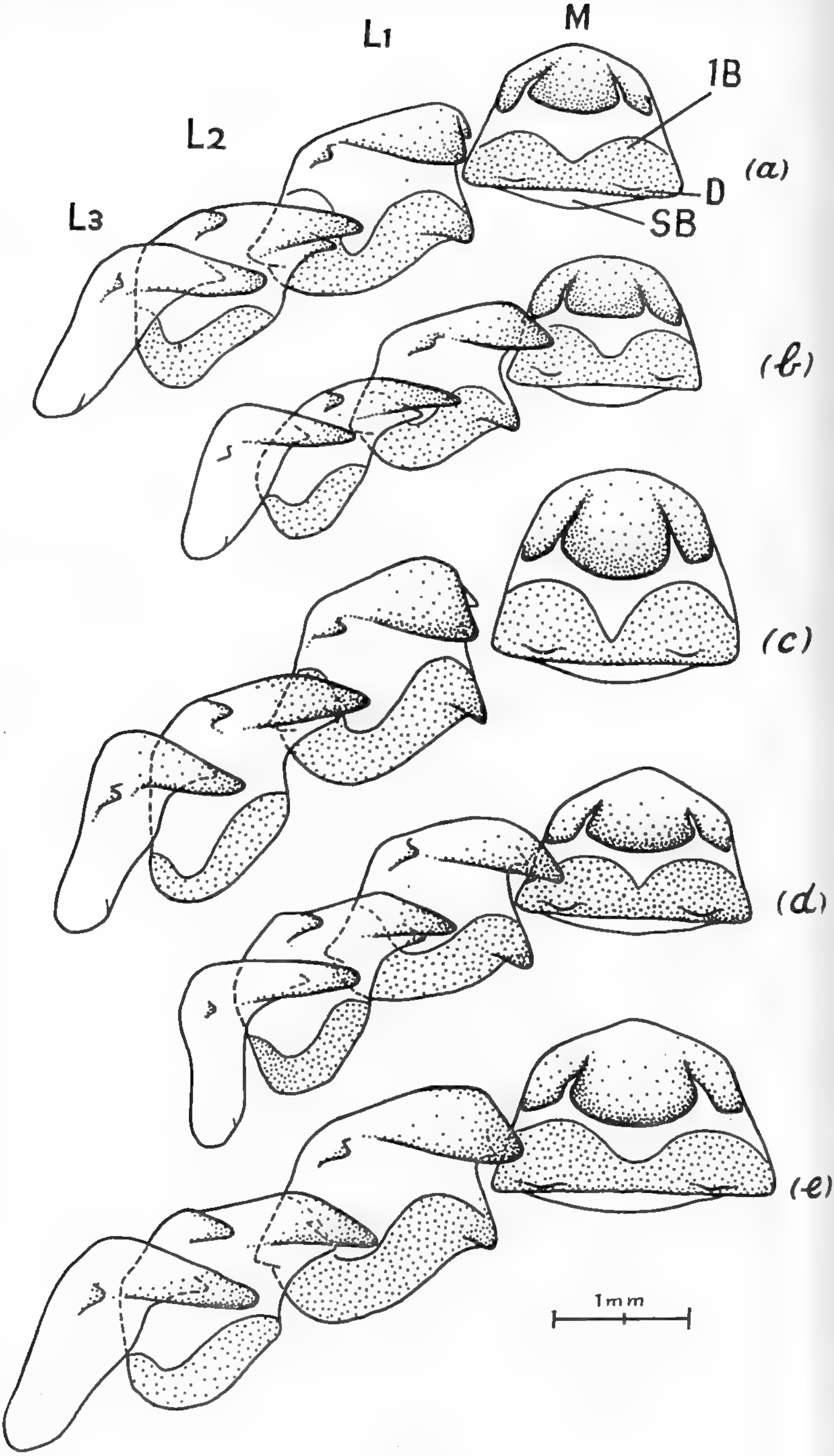
The first lateral tooth (= "admedian" of Kay) is slightly higher than it is wide. It possesses a prominent medial cusp which is large and pointed while the lateral cusps are relatively small. A densely staining internal bract also occurs in this tooth. Large denticles are present on the lower corners of the tooth, the one on the inner corner being particularly prominent and projecting toward the median tooth. The second lateral tooth is similar to the first but is narrower with a more prominent central cusp and does not possess basal denticles. The third (outer) lateral is narrower still, its lateral cusps are very reduced, no internal bract is visible, and there are no basal denticles.

The shape and proportions of the median tooth and the second lateral tooth vary slightly. The median tooth of South Australian and Esperance specimens tends to be lower and wider than that of west coast animals. There are indications that this may be clinal character. In South Australian and Esperance specimens the outer lateral cusp on the second lateral tooth forms a distinct shoulder. This is present but less distinct in Geographe Bay and Sorrento samples. The specimens from Cockburn Sound (text fig. 4b) are exceptional in that the second lateral tooth is relatively narrow and there is no shoulder at the outer lateral cusp. This is consistent in specimens from this locality but appears to be a local feature, not a regional one (cf. nearby Sorrento animals).

On the whole there is little variation in the radula in this species complex. The variants described above do not appear to provide any satisfactory basis for subdividing the group into races or species, although a more detailed biometric study may be necessary to be sure of this. It will be interesting to examine the radulae of pale shells from deep water when these become available.

Text fig. 3. Sample statistics of three shell characters plotted against distance in miles from the most northern locality (Shark Bay). Solid circles represent single specimens. For detailed sample and locality data see table 1.

TL = Total Length; TW = Total Width; AL = Aperture Length; AW = Aperture Width; SH = Spire Height.


M
L1
L2
L3
1B
D
SB
(a)
(b)
(c)
(d)
(e)
1mm

(7) *Animal colour*: One of us (BRW) has studied living and preserved specimens from the Fremantle area, Geographe Bay, Esperance and South Australia. There is little intra-population variation in the colouring of the animal from any of these localities, and no evidence of any inter-population variation. The mantle, head, eye, tentacles, siphons, and sides of the foot are jet black. Mantle papillae are widely spaced and so small that they are barely visible in a fully extended living animal. The anterior end of the foot is truncated and the shallow groove along the leading edge is yellow. This yellow streak may sometimes extend about an inch back along the latero-ventral edges of the foot. The base of the foot is dark gray or black.

It would be interesting to know whether the animals living below 50 fathoms lack dark pigments in the soft parts as well as in the shell.

(8) *Shell colour*: It is important to distinguish between colour pattern and colour intensity.

(a) *Colour pattern*: In all specimens with any shell colour present the shells show the basic dorsal and lateral pattern as described above for shallow water west coast *Z. friendi*.

In most shells, except those from South Australia, the solid dark pigment on the base extends from the lateral callouses to the edges of the aperture (but not into the tooth interstices which are white). Invariably the base colour of South Australian shells does not reach the sides of the aperture, *i.e.*, the aperture is bounded by a white patch on each side (pl. 2, fig. j). By this character South Australian shells can always be recognized, and it seems to be a useful systematic criterion. However, several specimens in the Esperance sample show a slight loss of colour from the sides of the aperture. This suggests that there may be intergrades of this character between Esperance and South Australia in which case the character can have no systematic value. Specimens from intermedite localities are needed.

(b) *Colour intensity*: Specimens trawled from 70-100 fathoms in the western part of the Great Australian Bight (*i.e.*, specimens known as *Z. thersites contraria*) generally have the same basic pattern as shallow water *Z. friendi*, but there is a marked loss of the dark brown shell pigments. The underlying radial bands are either very pale orange or absent. The dorsal blotches are generally few and reduced to pale orange and the overlying pigmentaton of the sides is similarly reduced. The lateral spots are usually more obvious in these deep water shells as the density of the overlying pigments is less. In some shells all traces of colour pattern are lost and the shell is entirely off-white, but all intermediate stages are present in our sample.

It is significant that in all specimens from this area with some pigmentation of the base the colour extends from the lateral callouses to

---

Text fig. 4. Radulae of specimens from: (a) Sorrento (WAM 36-62); (b) Cockburn Sound (WAM 53-62); (c) Geographe Bay (WAM 1-62); (d) Esperance (WAM 73-62) and (e) Sir Joseph Banks Group, Spencer Gulf (WAM 61-62). Radulae stained with chlorazol black; stippling indicates density of stain.

M, medium tooth; L1-3, lateral teeth; IB, internal bract; D, denticle; SB, sub-tending bract.

the sides of the aperture. In this respect they resemble *Z. friendi* from Esperance and westward rather than South Australian shells.

There is a single specimen in the Western Australian Museum collection which was trawled by the "Endeavour" in 1912 "between Fremantle and Geraldton in 80-100 fathoms," with white sides, base and dorsum. The dorsum is slightly flecked with orange-gray spots. That this shell is correctly placed in the *Z. friendi* complex is supported by darker shells of similar shape from intermediate depths (*e.g.*, pl. 1, fig. a). A recent dredging expedition by the Western Australian Museum produced many basal fragments of similar shells from 85-110 fathoms, approximately 20 miles N.N.W. off Rottnest Island, Western Australia. These fragments are all either white or pale orange, some with orange lateral spots. They were associated with a belt of white sponges and bryozoa.

There is great intra-locality variability in the shape, size and number of the dorsal blotches, but there appears to be little variation between shallow water populations from one end of the range to the other. However, there is a marked tendency for a decrease in the number of dorsal blotches in deep water shells; they may be absent in some specimens from the outer edge of the continental shelf (see below).

The radial bands are generally at least partially visible but may be obscured by the dorsal blotches in particularly dark shells. Similarly the large round lateral spots are generally present but are often obscured by the dense brown of the sides.

Thus it seems likely that a pale form of *Z. friendi* occurs all along the outer edge of the continental shelf off southwestern Australia. The specimen dredged by Verco (1912) in 72 fathoms in the Great Australian Bight is so far the shallowest record for the pale shells. In the same publication Verco records a dark specimen of *Z. thersites* dredged in 40 fathoms off Kangaroo Island, South Australia. There is a dark specimen in the Marwick (the late T. W. Marwick of Perth) collection from 40 fathoms in the Recherche Archipelago, and all other specimens examined from less than 40 fathoms in Western Australia are dark. The loss of colour must therefore begin between 40 and 70 fathoms.

This loss or reduction of shell colour intensity is almost certainly eco-phenotypic. It may be a direct or indirect result of decreased light. The shells of all other molluscs dredged from the white sponge belt off Rottnest were white or pale orange (even the filter feeding lamellibranchs) and it seems unlikely that the loss of the brown and blue pigments in *Z. friendi* is due solely to the lack of these pigments in their food (*i.e.*, white sponges ?). If the loss of pigment is a direct function of depth we should expect it to be clinal which appears to be the case.

DISCUSSION

Diagnostic characters used to separate subspecies or closely related species must be relatively consistent and characteristic of a geographical region not just a local population. They should be discontinuous. Clinal characters are useful in few circumstances, while eco-phenotypic and genetic variants restricted to local populations, or demes, are unacceptable as systematic characters.

Most of the characters examined in this study of the *Z. friendi* species complex show exceptional variation, either inter-locality, intra-locality or both. We have assigned each of these variants to one of the four categories listed below.

(i) *Intra-locality variants*: The number of dorsal blotches and position of the spire apex in relation to the posterior channel (Esperance population) are the most striking examples, but most characters show consider-

able variation within samples from a single locality. The degree of intra-population variation in the *Z. friendi* complex emphasizes the need for large series of specimens in similar studies.

(ii) *Inter-locality variants restricted to small localized demes (i.e., no geographical pattern)*: Overall size, amount of upturning of the anterior and posterior channel sides, and possibly aperture width, vary from one locality to another, apparently without any geographical pattern. Occasionally a single population may be characterized by a particular variant which elsewhere does not vary much at all, *e.g.*, the shape of the second lateral radula tooth of Cockburn Sound animals; or which varies clinally over the remaining range of the species, *e.g.*, the extreme offset spire of Sorrento animals.

Some of these random inter-locality variants are almost certainly eco-phenotypes, *e.g.*, overall size, but other may have a genetic basis, possibly due to small size of the demes and lack of effective dispersal.

(iii) *Geographically continuous variants, i.e., clinal characters*: The two dimensional (horizontal and vertical) cline in relative width is a striking feature of this species complex. With it is associated position and height of the spire. Relative aperture width, shape of the central radula tooth and colour intensity may also be clinal.

(iv) *Geographically discontinuous variants*: The only characters which appear to fall within this category are the presence of posterior columellar teeth and base colour. South Australian shells may always be recognized by the white patch on each side of the aperture and generally by the presence of 1 to 4 posterior columellar teeth or crenulations. No other shell characters seem to be acceptable for the subdivision of the species complex into related species or races.

As far as is known to the authors no specimens have been collected between the western part of the Great Australian Bight and Streaky Bay in South Australia. This is a particularly inaccessible stretch of coast and, although this gap in the records may be due to a real absence of individuals there, it may be due to lack of collecting. Therefore we cannot discount the possibility that the two characters described above as discontinuous variants may also be clinal, with inter-grades between Esperance and Streaky Bay. On the other hand if there is a real gap in the species distribution in the central Bight area, then two allopatric systematic units may be recognized within the species complex. One of these units would extend across the full width of the continental shelf from Shark Bay to the western part of the Bight, and the other restricted to comparatively shallow water along the coast of South Australia. If this is so, then South Australian populations must receive some level of taxonomic recognition. A final decision must wait until an intensive search has been made along the shores of the central section of the Great Australian Bight.

Much of the inter-locality variation seen in this group is probably eco-phenotypic, some probably has a genetic basis which may be accounted for in part by restricted larval dispersal. In this respect the species may be compared with *Cymbiolacca pulchra* studied by McMichael (1959) and species of *Notocypraea* studied by Griffiths (1962a). However, the variation within the *Z. friendi* group is even more complicated by the strong clinal trends of some characters. That section of the Australian coastline between Shark Bay and South Australia is characterized by an absence of marked geographical barriers and by a slow gradient in surface water temperature (see text fig. 1). Clines should therefore be expected in species which are widely distributed along this coastal gradient.

The data presented here draw attention to the inadequacies of the

current nomenclature of the group and emphasize the need for great care in taxonomic studies of the Cypraeidae. Information on the biology and life history of cowries is urgently needed to provide background for such studies.

TAXONOMIC CONCLUSIONS

In the absence of specimens from localities in the Great Australian Bight, between Esperance and Streaky Bay, we propose provisionally to follow Verco (1918) and recognize only one species with two subspecies in this highly variable complex.

Zoila friendi friendi (Gray, 1831).

Cypraea friendii Gray, 1831, *Zool. Miscell.*, p. 35 (New Holland, near Swan River [type locality here restricted to Cockburn Sound and Owen Anchorage between Garden and Carnac Islands and the mainland]). Lectotype, selected by S. P. Dance, Brit. Mus. (N.H.), regn. no. 1964777.

Cypraea scottii Broderip, 1831 [July, 1832], *Zool. J.*, 5:330 (Strait of Sunda, near Angia, Java). Sowerby, 1837, corrected the locality to Garden Island, Swan River. Type not located.

Cypraea thersites Gaskoin. Verco, 1912, *Trans. Roy. Soc. S. Aust.*, 36:209-210 (in part, *i.e.*, three specimens dredged from 78-100 fms. west of Eucla, Great Australian Bight).

Cypraea friendii friendii Gray. Verco, 1918, *Trans. Roy. Soc. S. Aust.* 42:144-145.

Zoila friendii vercoi Schilder, 1930, *Zool. Anz.*, Leipzig, 92:74 ("westliche Südküste von Australien; Typus: das mittelgrosse [South Aust. Mus. regn. no. D14124], von Verco 1918, *Trans. R. Soc. South Austr.*, Vol. 42, p. 147, erwähnte Stück von Esperance).

Zoila thersites contraria Iredale, 1935, *Aust. Zool.* 8:107 (72-100 fms. west of Eucla, Great Australian Bight). The types are the specimens collected by Verco (Verco, 1912). Lectotype, here selected, Australian Mus. Sydney regn. no. C35580; also two paralectotypes Australian Mus. regn. no. E3848 and E3839.

Zoila friendii friendii Gray. Schilder and Schilder, 1938-39, *Proc. Malac. Soc. Lond.* 23:174.

Zoila friendii contraria Iredale. Schilder and Schilder, 1938-39, *Proc. Malac. Soc. Lond.* 23:174.

Cypraea contraria Iredale. Griffiths, 1962, *the Cowry,* 1:36-38.

Range: Shark Bay to the western part of the Great Australian Bight at depths of a few fathoms to at least 110 fathoms.

Diagnosis: Shell colour varies from almost totally dark brown (some inshore shells) to entirely off-white (some deep water shells), but when any pigmentation of the base occurs it extends from the lateral callouses to the edges of the aperture. There are only 4 to 8 strong anterior columellar teeth and no posterior columellar teeth, although specimens at the northern end of the range possess faint crenulations all along the columella.

There is no evidence to support the status of Western Australian south coast populations as a distinct race of *Z. friendi.* The shell characters previously used to diagnose this supposed race (*i.e., vercoi*) are all either clinal or subject to non-geographical, inter-locality variation. The evidence presented in this paper clearly indicates that the deep water pale shells (*i.e., contraria*) are ecotypes of Western Australian *Z. friendi* and could not be regarded as a western race of *Z. thersites,* even if *thersites* were a valid species.

Zoila friendi thersites (Gaskoin, 1849).

Cypraea thersites Gaskoin, 1849, *Proc. Zool. Soc. Lond.* for 1848, 16:90 (Hab. ? [Roberts, 1885 [in], Tyron, Man. of Conch. gives South Australia]). Lectotype, selected by S. P. Dance, Brit. Mus. (N.H.) regn. no. 1846.5.15.1, bears no locality.

Cypraea friendii thersites Gaskoin. Verco, 1918, *Trans. Roy. Soc. S. Aust.*, 42:144-148.

Zoila thersites thersites Gaskoin. Iredale, 1935, *Aust. Zool.*, 8:107.

Zoila friendii thersites Gaskoin. Schilder and Schilder, 1938-39, *Proc. Malac. Soc. Lond.*, 23:174.

Zoila thersites Gaskoin. Schilder, 1961, *The Veliger*, 4:110.

Range: Streaky Bay to Beachport in South Australia down to depths of 40 fathoms.

Diagnosis: Differs from *Z. friendi friendi* in having a white patch on each side of the aperture. No deep water pale specimens are yet known. Generally there are 1 to 4 relatively strong teeth at the posterior end of the columella in addition to the usual 4 to 8 strong anterior columellar teeth. This eastern subspecies needs confirmation.

ACKNOWLEDGEMENTS

We wish to extend our thanks to the many collectors who generously loaned specimens from their private collections for this study and to the Directors and Curators of the Western Australian Museum, National Museum of Victoria and the Australian Museum, Sydney, for their co-operation in allowing us to examine their collections. To Dr. R. W. George we are grateful for invaluable help in the field and in preparation of this manuscript. Dr. E. P. Hodgkin, Dr. W. J. Clench, Dr. Ruth Turner and Dr. R. Tucker Abbott kindly read the manuscript.

ADDENDUM

After submission of this paper additional information came to hand which strongly supports the ideas put forward. Two Fremantle fishermen, the Poole Bros., brought into the W.A. Museum ten specimens of *Z. friendi* all trawled in 60 fms. W. of Dorre Is. (Shark Bay) in July, 1965. This is the most northerly confirmed record of the species. They are dark and in shape and dentition resemble other specimens from deep water north of Fremantle. Mean length of the series is 7.52 cm., range 6.82-8.23 cm. Mean W:L is 0.648, range 0.600-0.675. From dorsal view these shells would easily be mistaken for shallow water shells from Esperance, although they all possess the full series of crenulations along the columellar side so characteristic of northern populations.

PLATE 1. Dorsal views, approximately half natural size;
(a) WAM 67-62, 25 fms., off False Entrance.
(b) WAM 36-62, 2 fms., off Sorrento.
(c) WAM 53-62, 2 fms., Parmelia Bank, Cockburn Sound.
(d) WAM 39-62, 2 fms., Parmelia Bank, Cockburn Sound.
(e) WAM 43-62, 2 fms., Parmelia Bank, Cockburn Sound.
(f) WAM 24-63, 3 fms., off Quindalup, Geographe Bay.
(g) WAM 1-62, 8 fms., off Quindalup, Geographe Bay.
(h) WAM 28-63, 4 ft., Quindalup, Geographe Bay.
(i) WAM 70-63, 3 fms., Esperance.
(j) WAM 73-63, 3 fms., Esperance.
(k) WAM 56-63, 3 fms., Esperance.
(l) WAM N1996, ? fms., King George Sound.
(m) WAM 61-62, 2 fms., Sir Joseph Banks Group, Spencer Gulf.

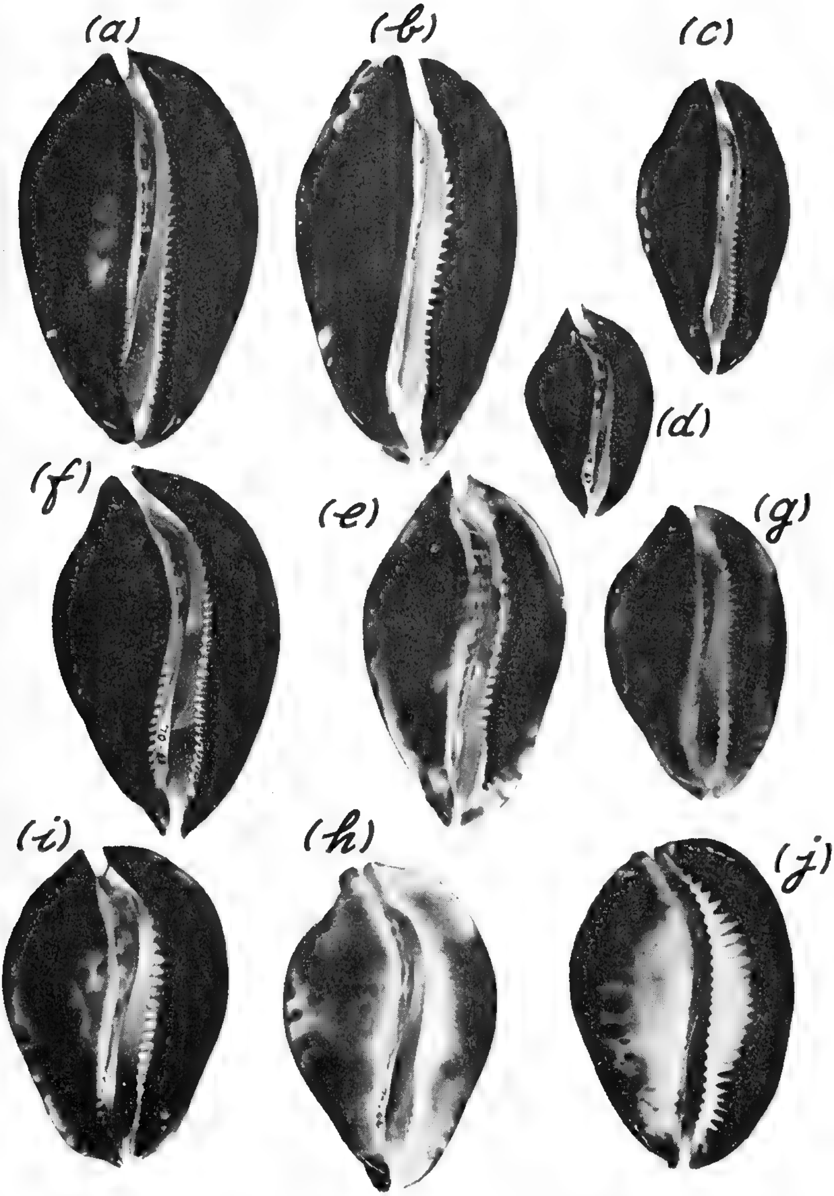


PLATE 2. Ventral views, approximately half natural size;
(a) WAM 67-62, 25 fms., off False Entrance.
(b) WAM 36-62, 2 fms., off Sorrento.
(c) WAM 53-62, 2 fms., Parmelia Bank, Cockburn Sound.
(d) WAM 28-63, 4 ft., Quindalup, Geographe Bay.
(e) WAM 24-63, 3 fms., off Quindalup, Geographe Bay.
(f) WAM 70-63, 3 fms., Esperance.
(g) WAM 56-63, 3 fms., Esperance.
(h) WAM 73-63, 3 fms., Esperance.
(i) WAM N1996, ? fms., King George Sound.
(j) WAM 61-62, 2 fms., Sir Joseph Banks Group, Spencer Gulf.

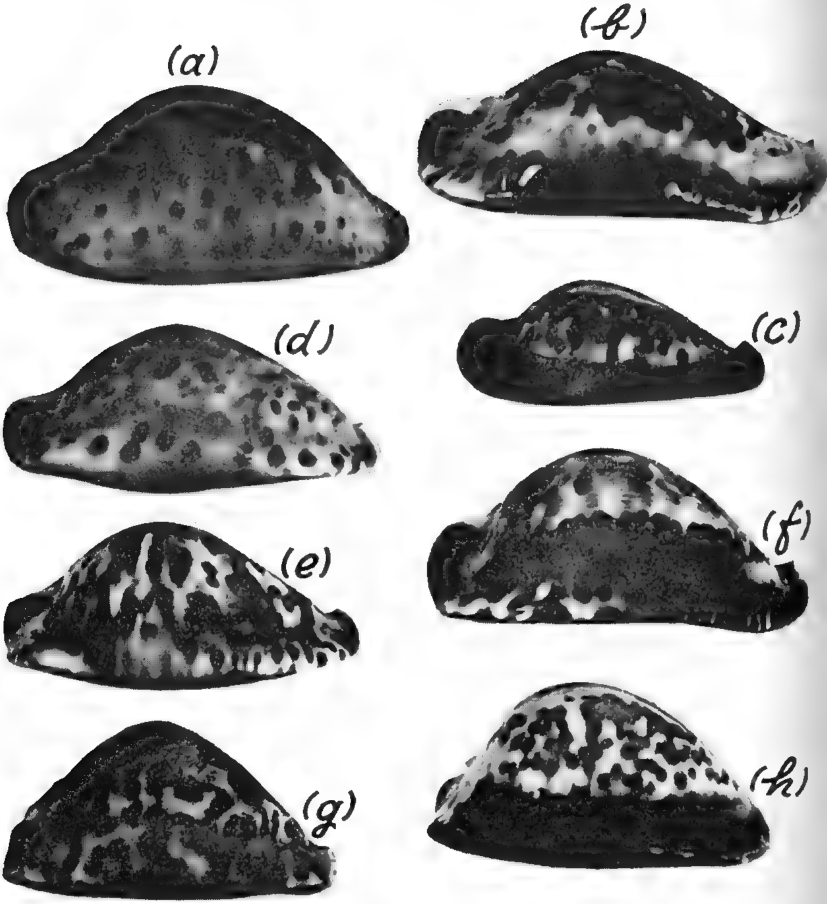


PLATE 3. Lateral views (right side), approximately half natural size;
(a) WAM 67-62, 25 fms., False Entrance.
(b) WAM 36-62, 2 fms., off Sorrento.
(c) WAM 53-62, 2 fms., Parmelia Bank, Cockburn Sound.
(d) WAM 24-63, 3 fms., off Quindalup, Geographe Bay.
(e) WAM 1-62, 8 fms., off Quindalup, Geographe Bay.
(f) WAM 70-63, 3 fms., Esperance.
(g) WAM N1996, ? fms., King George Sound.
(h) WAM 61-62, 2 fms., Sir Joseph Banks Group, Spencer Gulf.

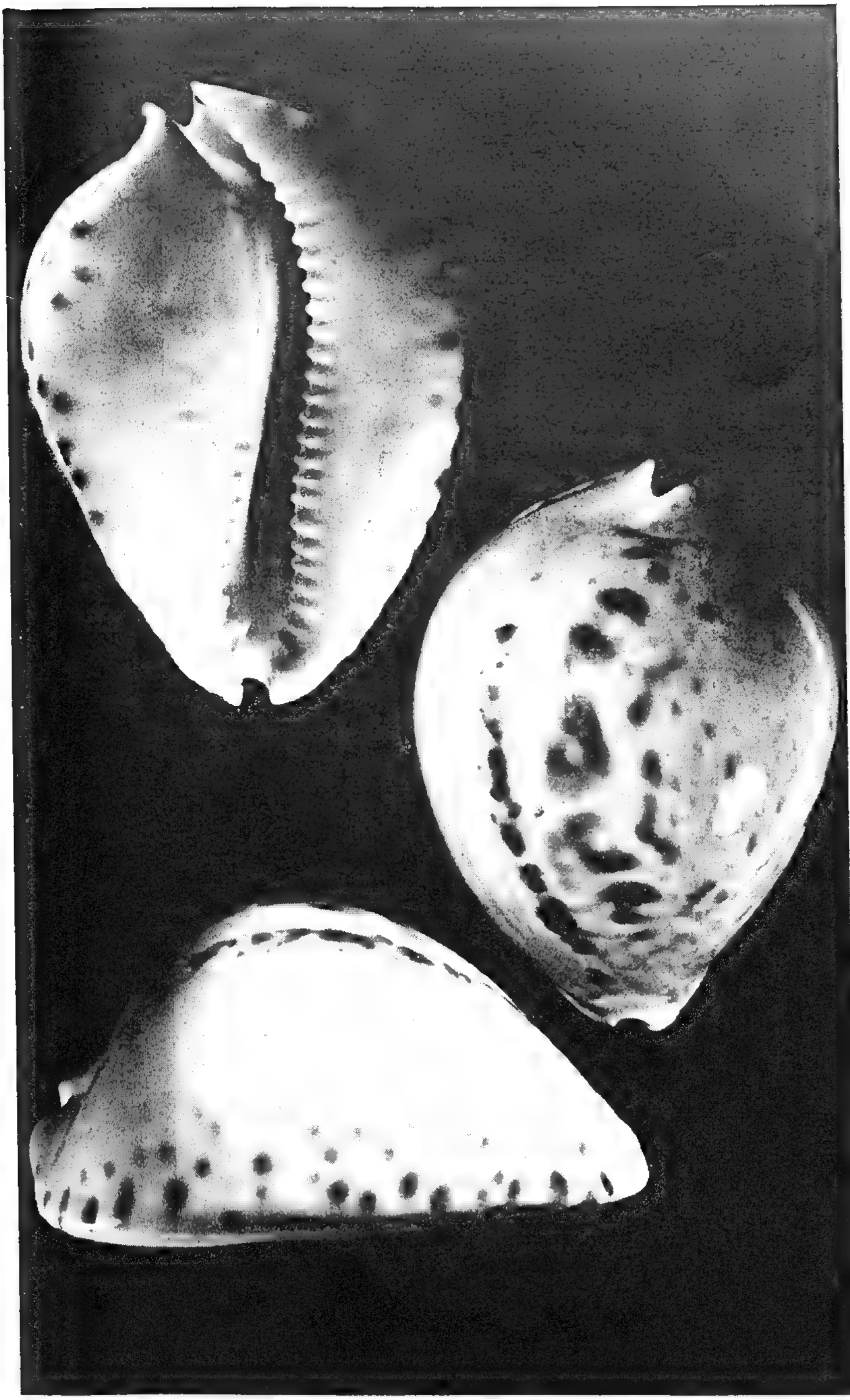


PLATE 4. Dorsal, Ventral and Lateral views, approximately natural size, Lectotype of *Zoila thersites contraria* Iredale, A.M. C.35580, 72 fm., 60 m. W. of Eucla.

LITERATURE CITED

ALLAN, JOYCE, 1956. *Cowry Shells of World Seas.* Georgian House, Melbourne, p. 27.

CAIN, ARTHUR J., and PHILLIP M. SHEPPARD, 1950. Selection in the polymorphic land snail *Cepaea nemoralis. Heredity,* 4:275-294.

COTTON, BERNARD C., 1958. Western Australian cowries. *J. Malac. Soc. Aust.,* 2:12.

DIVER, C., 1939. Aspects of the study of variation in snails. *J. Conch.,* 21:91-141.

GRIFFITHS, R. J., 1962a. A review of the Cypraeidae genus *Notocypraea. Mem. Nat. Mus., Melb.,* 25:211-231.
————, 1962b. List of species. *The Cowry,* 1:35-38.

IREDALE, TOM, 1935. Australian Cowries. *Aust. Zool.* 8:107.

KAY, ALISON, 1960. Generic revision of the Cypraeinae. *Proc. Malac. Soc. Lond.,* 33:278-287.

KINCAID, TREVOR, 1957. *Local races and clines in the marine gastropod Thais lamellosa Gmelin. A population study.* Calliostoma Co., Seattle, Washington.

LELOUP, EUGÈNE, 1950. Exploration hydrobiologique du Lac Tanganika (1946-7). *Résult. Sci.,* 3, Lamellibranchs.
————, 1953. *Ibid.,* 3, Gastéropodes.

McMICHAEL, DONALD F., 1959. Marine mollusca of Eastern Australia. I. The genus *Cymbiolacca* Iredale (Family Volutidae). *Aust. Zool.,* 12:374-383.

ORR, VIRGINIA, 1959. A bionomic shell study of *Monetaria annulus.* (Gastropoda: Cypraeidae) from Zanzibar. *Notul. Nat. Acad. Philad.* no. 313.

OSTERGAARD, JEAN MATHIAS, 1950. Spawning and development of some Hawaiian marine gastropods. *Pacif. Sci.,* 4:75-115.

SCHILDER, FRANZ ALFRED, 1930. Beiträge zur Kenntnis der Cypraeacea (Moll., Gastr.). III. *Zool. Anz.,* 92:74.
————, 1961. Another statistical study in the size of cowries. *The Veliger,* 4:110.

SCHILDER, FRANZ ALFRED, and MARIA SCHILDER, 1938-39. Prodrome of a monograph of living Cypraeidae. *Proc. Malac. Soc. Lond.,* 23:174.

TRENBERTH, PAUL, 1962. Observations on *Zoila thersites* Gaskoin, 1849. Hawaiian Shell News, 11, (2) :8.

VERCO, JOSEPH C., 1912. Shells from the Great Australian Bight. *Trans. Roy. Soc. S. Aust.,* 36:209-210.
————, 1918. Notes on South Australian marine mollusca, with descriptions of new species. *Ibid.,* 42:144-148.

WELCH, D'ALTE, 1938. Distribution and variation of *Achatinella mustelina* Mighels in the Waianae Mountains, Oahu. *Bull. Bishop Mus., Honolulu,* 152:1-164.

DESCRIPTIONS OF AUSTRALIAN EOLIDACEA (MOLLUSCA: OPISTHOBRANCHIA)

3. THE GENERA *TULARIA, EMBLETONIA* AND *AUSTRAEOLIS*, WITH A NOTE ON *TERGIPES PAUCULAS* BURN, 1962.

By ROBERT BURN*

Text figures 1-18.

SUMMARY

The diagnosis of the Favorinid genus *Austraeolis* Burn (1962) is completed by a study of more material, and two new species, *A. westralis* and *A. benthicola*, are described. A new Eubranchid genus *Tularia* is described with *Cuthona bractea* Burn (1962) as type species, and the Cuthonid *Embletonia gracilis* Risbec (1928) is recorded from Australia for the first time. A re-examination of *Tergipes pauculas* Burn (1962) shows it to be a mutilated specimen of *Babaiella serrata* (Baba, 1949).

INTRODUCTION

The first two papers in this series (1963, 1964) dealt with the Australian species of the genera *Nossis* Bergh (1902), *Eubranchus* Forbes (1838), *Trinchesia* Ihering (1879), *Toorna* Burn (1964) and *Herviella* Baba (1949). Seven species were described and figured. The present paper deals with three more genera, *Tularia* gen. nov., *Embletonia* Alder and Hancock (1851) and *Austraeolis* Burn (1963), and five species of which two are described as new.

The material examined for this research has been deposited in the National Museum of Victoria, Melbourne (N.M.V.), the Australian Museum, Sydney (A.M.), or the Western Australian Museum, Perth (W.A.M.), depending upon the State of origin.

The writer wishes to thank in particular the Trustees of the Science and Industry Endowment Fund, C.S.I.R.O., for a grant in aid of research on the Australian opisthobranchs. This paper is part of a comprehensive study of the Opisthobranchia of Australia being undertaken by the writer. Due acknowledgement is also made to the Directors and Molluscan Departments of the National Museum of Victoria, Melbourne, the Australian Museum, Sydney, and the Western Australian Museum, Perth, for the loan of material and literature.

* Hon. Associate in Conchology, National Museum of Victoria, Melbourne, Victoria.

SYSTEMATIC SECTION

ORDER NUDIBRANCHIA
SUBORDER EOLIDACEA
SUPERFAMILY ACLEIOPROCTA
FAMILY EUBRANCHIDAE

TULARIA gen. nov.

Diagnosis: Acleioproct Eolidacea with triseriate radula (median tooth denticulate, lateral teeth plate-like without denticles) and a single row of denticles on the masticatory borders; with simple or roughened rhinophores and tentaculiform foot corners; without penial gland or prostatic vas deferens, penis unarmed; right liver with 4 simple rows of cerata.

Type species: *Cuthona bractea* Burn (1962: 110).

Remarks: *Tularia* has several special negative characteristics hitherto not recognized among Eubranchid genera or species, i.e., absence of penial gland, prostatic vas deferens and penial stylet. The genus is otherwise very close to *Eubranchus* Forbes, 1838 (Lemche, 1964: 40-44); which has rounded foot corners and penial gland. Tentaculiform foot corners and unarmed penis occur in *Galvinella* Eliot (1907), but that genus has cerata on the middle of the back and the anus in the middle line. *Egalvina* Odhner (1929) has a simple penis and very distinctive laterally branching liver rows. *Cumanotus* Odhner (1907) has an unarmed penis, two hook-bearing pads at the genital aperture and finely denticulate rhachidian and lateral teeth. *Capellinia* Trinchese (1874) has a stylet arming the penis.

Tularia originated from an Australian aboriginal word 'tulari', meaning a species of fish.

Tularia bractea (Burn).

Figures 1-4.

Cuthona bractea Burn, 1962: 110, fig. 11-12.

Material examined: VICTORIA: Point Danger, Torquay; 31 March, 1963, 1 specimen, N.M.V. reg. no. F25,654; 18 January, 1965, 1 specimen, N.M.V. reg. no. F25,655; both specimens collected by the writer.

Habitat: Crawling on brown algal tips in tide pools, under stones at low tide level (Burn, loc. cit.).

Description: The two topotypical specimens examined alive were respectively 10 and 14 mm. long. The smaller specimen was yellowish in colour with the lower two-thirds of the rhinophores mauve, some larger cerata were purple on the outer side and some smaller lateral ones had a dark orange superficial pigment; the cnidosacs were yellowish, the digestive glands grey-black. The larger specimen was creamy-white, everywhere marked with bluish-white epidermal pigment patches and small orange pigment cells; rhinophores, tentacles and anterior edge of foot white; cerata greenish-yellow with a wide band of burnished red below the cream cnidosacs, everywhere marked with small orange pigment cells and shining white ceratal glands, digestive glands pale green.

Small tentaculiform foot corners are characteristic. The rhinophores are roughened. The liver branching (fig. 1) consists of four rows of up to 4, 5, 6, 6 cerata in the right liver, behind which lie six rows of up to 6, 6, 5, 4, 3, 2 cerata. The cerata are slender fusiform, finely pointed, the cnidosacs are about one-sixth the cerata length. In the larger slug, the cerata rows stand up marginally above the body sides and the lower end hangs free. The genital aperture (*b*) lies below the third and fourth rows of the right liver, the anus (*a*) opens in front of the first row posterior liver right side and the renal pore (*c*) lies in front of this.

The 0.7 mm. long pale yellow jaws (fig. 2) are elongate oval, strongly convex and thickened anteriorly. The masticatory borders have about 20 pointed denticles. The colourless radula (fig. 3) comprises 27 rows of 1.1.1 teeth plus 3-5 small rachidians in an ascus-like heap. The rachidian has a short cusp and 4-5 denticles each side; the lateral teeth are as wide as long, with a single attenuated cusp.

The reproductive organs (fig. 4) have a large reniform ampulla (*d*) which distally bifurcates to the female gland mass and the male duct. The slender vas deferens (*e*) is short and coiled, the penial sheath (*g*) large and muscular. The penis (*h*) fills the whole lumen of the sheath; it is apicially rounded and unarmed. The spermatheca (*i*) was dislodged and crushed in dissection; it is probably pyriform.

Discussion: Examination of topotypical specimen of *Cuthona bractea* shows that the radula is triseriate and not uniseriate as originally reported (Burn, 1962: 111). This necessitates the transfer of the species from the Cuthonidae to the Eubranchidae.

The pretty yellow coloration of *G. bractea* distinguishes it from all other Australian eolids. *Eubranchus rubeolus* Burn (1964: 13) which lives on the same coastline has a white body with red patches and dark red cerata.

FAMILY CUTHONIDAE

SUBFAMILY TERGIPEDINAE

Genus *EMBLETONIA* Alder and Hancock (1851).

Diagnosis: Acleioproct Eolidacea with a uniseriate radula (prominent cusp and smaller lateral denticles) and a single row of denticles on the masticatory borders; with simple rhinophores, broad velum and rounded foot corners; with penial stylet and prostatic vas deferens (but no penial gland); right liver with two rows of one ceras each.

Type species by monotypy: *Pterochilus pulcher* Alder and Hancock (1844: 329), = *Embletonia pulchra*. The genus *Pterochilus* Alder and Hancock (loc. cit.) is preoccupied.

Remarks: This genus and *Tenellia* differ from the other Cuthonid genera, in fact all eolid genera, in that the tentacles are replaced by a broad velum. *Tenellia* A. Costa (1866) has two rows of two or more cerata in the right liver to separate it from *Embletonia,* and is further separated by the presence of a penial gland in the reproductive system.

Embletonia gracilis Risbec.

Figure 5.

Embletonia gracile Risbec, 1928: 271, pl. 12, fig. 11, text fig. 91.
Embletonia gracile. Risbec, 1953: 139, fig. 94, 96.
Embletonia gracile. Baba, 1959: 335, pl. 29.
Embletonia gracile. Baba, 1963: 399.

Material examined: VICTORIA: Point Danger, Torquay; 3 January 1965, 1 specimen, collected by the writer, N.M.V. reg. no. F25,656.

Habitat: Beneath stone in channel at low tide.

EXPLANATION OF FIGURES

Text figs. 1-4. *Tularia bractea* (Burn).
1. Right lateral view of preserved slug.
2. Jaw.
3. Radular teeth.
4. Genital organs.

Text fig. 5. *Embletonia gracilis* Risbec—dorsal view of living slug.

Text figs. 6-10. *Austraeolis ornata* (Angas).
6. Dorsal view of living slug.
7. Liver system.
8. Jaw.
9. Radular tooth.
10. Genital organs.

Abbreviations: *a*—anus; *b*—genital aperture; *c*—renal pore; *d*—ampulla: *e*—vas deferens; *f*—prostatic vas deferens; *g*—penial sheath; *h*—penis *i*—spermatheca; *j*—oviduct; *k*—penial flange.

Description: The living specimen (fig. 5) measured 4.5 mm. in length. The body was translucent white overlaid everywhere including the cerata with opaque white superficial pigment patches. Black eyes shine through the head. Digestive glands within body and cerata dull pink; cnidosacs translucent.

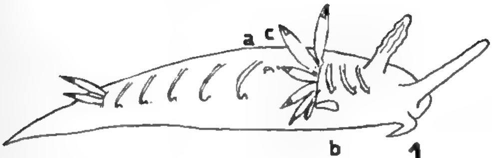
The body is fusiform, not elongate as in the type and Japanese slugs. The velum is broad, trilobate from above, but only bilobate from below. The foot corners are rounded, the sole narrow. Rhinophores short, simple and generally curved rearwards like a pair of horns. The fully developed cerata are very stout with a narrowed base and wider four-knobbed distal end. Each of the four knobs contains a small cnidosac filled with fusiform yellowish nematocysts. There are six cerata on the left side, only four on the right of which the anterior two belong to the right liver. The genital aperture lies below the cerata of the right liver, the anus opens close to the anterior base of the first ceras of the posterior liver right side. The cerata are carried nearly horizontally in life.

The animal has not been examined further.

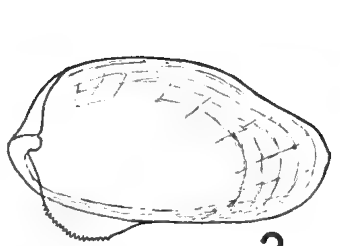
Discussion: With regard to the number of cerata, the specimen falls midway between *E. gracilis* with 7-8 pairs (Risbec, 1928: pl. 12, fig. 11; Baba, 1959: 335) and *E. paucipapillata* Baba (1963: 339) with 4-5 pairs. Like the former material, the specimen had short, stout cerata and for this reason alone it is identified with *E. gracilis*. However, it should be remembered that the specimen had a fusiform body which could indicate either specific or subspecific separation at a later date. *E. paucipapillata* was originally described as a subspecies of *E. gracilis*, but the slender fusiform body, fewer cerata and more delicate teeth justify specific status.

E. paucipapillata has been examined fully (Baba, 1963) and the genital organs figured (loc. cit.: fig. 7-8). Their structure is identical with that of *E. pulchra* (Alder and Hancock, 1844; Marcus and Marcus, 1958: pl. 18, fig. 8) except that there is no penial stylet as in the latter. Consequently, absence of a penial stylet and the peculiar four-knobbed shape of the cerata might justify generic separation for this species and its congeners.

This is the first record of the genus and species from Australia. It has hitherto been found only in New Caledonia and Japan.

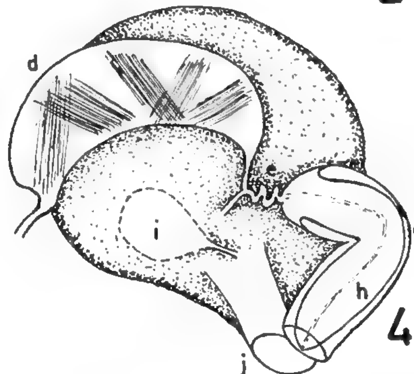


1

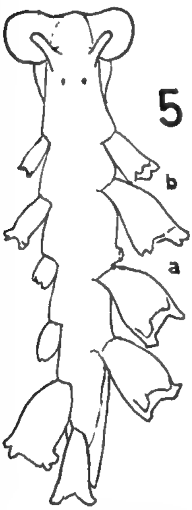


2

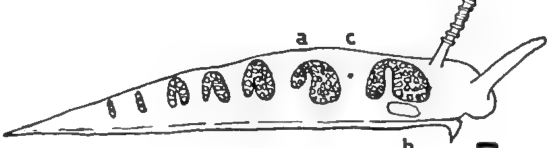
3



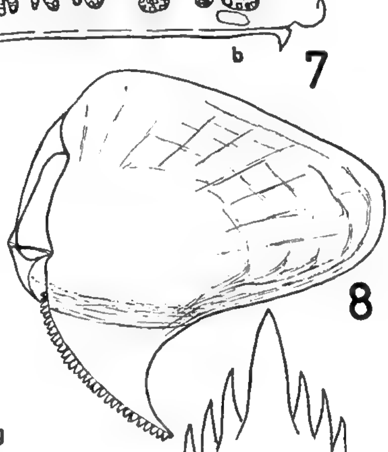
4



5

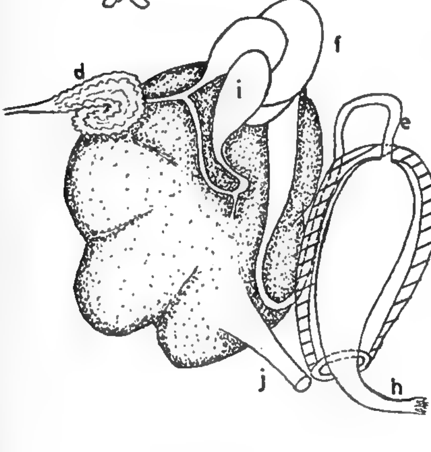


7



8

9



10

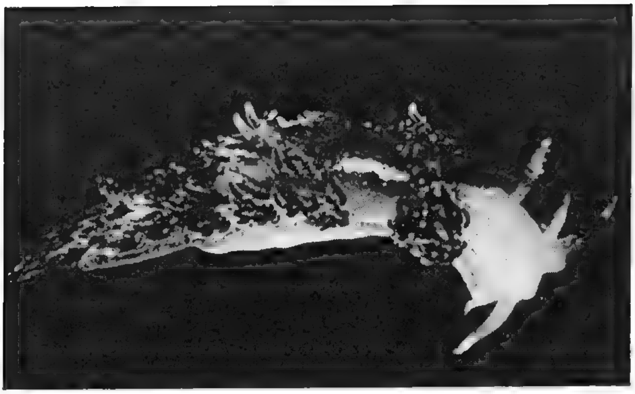


Fig. 6: *Austraeolis ornata* (Angas), Long Reef, New South Wales. Collected and photographed by A. Healy.

NOTE ON *TERGIPES PAUCULAS* BURN (1962: 113).

A re-examination and anatomical study of the unique specimen upon which the species *Tergipes pauculas* Burn (1962: 113) is based, shows that it is none other than a mutilated but regenerating specimen of *Cratena serrata* (Baba, 1949: 105, 179; Burn, 1962: 119). As in the Japanese description and Australian specimens, the jaws are quadrate with heavily denticulate tail-like masticatory borders and the radular teeth have a long cusp with fine denticles along each side. Consequently *T. pauculas* must be placed in the synonymy of *C. serrata*. Risso-Dominguez (1964: 223) has proposed a genus *Babaiella* for *C. serrata* and places it in the family Phyllodesmidae.

SUPERFAMILY CLEIOPROCTA
FAMILY FAVORINIDAE

Genus *AUSTRAEOLIS* Burn (1962: 120).

Diagnosis: The species of this genus are distinguished by three characteristics: (i) the asymmetrical liver arches with 4-7 irregular series of cerata on the broad anterior limb and 2-3 series of cerata on the narrow posterior limb, (ii) the ental prostatic vas deferens, and (iii) the ornamental fleshy armature of the penis. Furthermore, the three species of the genus have in common (*a*) annulate rhinophores, (*b*) tentaculiform foot corners, (*c*) a single row of denticles on the masticatory borders, and (*d*) a vertical flange on the anterior of the jaws.

Type species by original designation: *Flabellina ornata* Angas (1864: 67).

Remarks: The three species now referred to this genus are separated by differences in the shape of the jaws, radular teeth and penis. Externally, only *A. benthicola* is distinguished by its exceptionally wide foot. *A. ornata* is the most common eolid in eastern Australia where it ranges from Moreton Bay, southern Queensland, to Warrnambool, western Victoria. *A. westralis* is apparently common at its only known locality, Rottnest Island, south Western Australia. From the literature, *Austraeolis* appears to be peculiar to Australia.

A. fucia Burn (1962: 122) from Queenscliffe, Victoria, is most likely a preserved mutilated specimen of *Facelina hartleyi* Burn (1962: 116) and is not treated in this research.

Austraeolis ornata (Angas).

Figures 6-10.

Flabellina ornata Angas, 1864: 67, pl. 6, fig. 7.
Rizzolia australis Bergh, 1884: 27, pl. 9, fig. 1-5.
Flabellina ornata. Allan, 1950: 224, pl. 28, fig. 1.
Flabellina ornata. Dakin, 1952: 270, pl. 62, fig.
Hervia ornata. Burn, 1957: 24.
Austraeolis ornata. Burn, 1962: 121, fig. 21-22.

Material examined: QUEENSLAND: Dunwich, Greenmount. NEW SOUTH WALES: Woody Head, Angourie, Minnie Waters, South-West Rocks, Long Reef, Sydney Harbour, Maroubra, Wollongong, Ulladulla. VICTORIA: Flinders, Torquay, Warrnambool. A total of 70 specimens.

Habitat: Crawling among large boulders and beneath stones between tide levels, often in large numbers.

Description: Living slugs (fig. 6) grow to 35 mm. in length; preserved they rarely exceed 20 mm. The body colour is brilliant orange mottled white and cream and with small patches of shining blue. The cerata have dark brown or black digestive glands, superficial flecks of orange, red, yellow, brown, green or blue, or any combination of these, and cream cnidosacs.

The body (fig. 7) is rather wide, pointed behind and with insignificant foot margins. Foot corners small, tentacles long and tapering, rhinophores with 6-15 annulae. Liver system with five arches and two or one single rows on each side. Anterior arches very asymmetrical, posterior arches symmetrical. The right liver has 4-7 indistinct series of cerata standing upon the broad anterior limb and three or fewer series upon the slender posterior limb. The cerata are slender fusiform. The genital aperture (*b*) lies below the anterior limb of the right liver, the anus (*a*) opens on a papilla in the apex of the first posterior liver arch right side, and the renal pore (*c*) opens in the latter part of the interhepatic space.

The pale brown jaws (fig. 8) are 3.4 mm. long in a preserved slug 21 mm. in length; trigonal in shape, they have a vertical flange projecting from the anterior edge. The masticatory borders are deep with at least 26 large and 8 small conical denticles. The 23-29 radular teeth (fig. 9) have a stout cusp and three or four denticles each side.

The genital organs (fig. 10) have a glandular ampulla (*d*) which branches to the male and female ducts. The ental vas deferens (*f*) is thick, coiled upon itself three or four times and prostatic. The ectal part (*e*) is slender and passes within the muscular wall of the penial sheath before looping to enter the base of the penis. The penis (*h*) is elongate, tapering, slighting keeled on one side and tipped by six fleshy filaments. The spermatheca (*i*) opens to the inner oviduct, its distal part nestles in the coils of the prostatic vas deferens.

Discussion: *A. ornata* is a very distinctive species easily recognized by its brilliant colouration in life and by its asymmetrical liver arches in preserved material. *Rizzolia australis* Bergh (1884: 27) from Sydney Harbour is anatomically identical with the present material and must be placed in the synonymy. Bergh's description should be consulted for further details of this species.

Austraeolis westralis sp. nov.

Figures 11-14.

Material examined: WESTERN AUSTRALIA: Rottnest Island, 32° S., 115°30′ E.; north side of west end, 12 December, 1964, 1 specimen

(Holotype), R. P. McMillan, W.A.M. 180-64; Radar Reef, 3-4 January, 1965, 5 specimens (Paratypes), Shirley Slack-Smith, W.A.M. 104-65, 106-65; August, 1959, 1 specimen (Paratype), Sir Robert Blackwood, N.M.V. reg. no. F25,657.

Habitat: Beneath stones between tide levels.

Description: The largest preserved slug is 21 mm. in length. Preserved specimens have the same aspect as *A. ornata*, therefore it may be inferred that the living slugs have the coloration of that species. At present the specimens have cream bodies with brown to brown-purple cerata.

The body (fig. 11) is broad, the foot corners tentaculiform, the tentacles long, rhinophores with 12 or more annulae. Cerata in four arches and two or three single rows on each side. The right liver has 5-6 irregular series of cerata in the broad anterior limb and 2-3 series in the narrow posterior limb. The arches are more symmetrical posteriorly, the cerata are fusiform. Genital aperture (*b*) below anterior limb of right liver, anus (*a*) in the apex of the first arch posterior liver right side, renal pore (*c*) in the posterior part of the interhepatic space.

The brown jaws (fig. 12) are 3.5 mm. long in a 21 mm. long preserved slug; shape subovate, with vertical flange at anterior edge. Masticatory borders very deep with 20 large conical denticles on the lower edge and numerous small serrations above. Radula with 23 teeth (fig. 13), each with tapering cusp and 4-5 denticles each side.

Genital organs (fig. 14) generally as in *A. ornata*. Differences are narrower coiled prostatic vas deferens (*f*), larger outer vas deferens (*e*), stouter, i.e., shorter and broader penis (*h*) with numerous denticle-like fleshy serrations at the tip, and a more elongate spermatheca (*i*).

Discussion: *A. westralis* is outwardly all but identical with *A. ornata* from eastern Australia. Anatomical differences are more prominent in the rounded shape of the jaws, the slenderer radular teeth and the male parts of the genital organs. Without any doubt, both species have derived from a common origin within fairly recent times.

The lack of knowledge of the opisthobranch fauna of southern Australia, particularly between western Victoria and Rottnest Island, leaves open the possibility that *A. westralis* is an extreme form of *A. ornata*.

The specific name *westralis* is from the colloquial corruption 'Westralia', derived from Western Australia.

Austraeolis benthicola sp. nov.

Figures 15-18.

Material examined: NEW SOUTH WALES: off Ulladulla, 35°20′ S., 150°30′ E., 9 August, 1944, 1 specimen (Holotype), A.M. reg. no. C.63063.

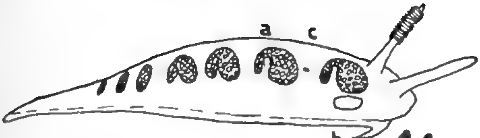
Habitat: Trawled on coarse sand in 80 m. depth.

Description: The single slug is 15 mm. long, the colour dull yellowish-grey.

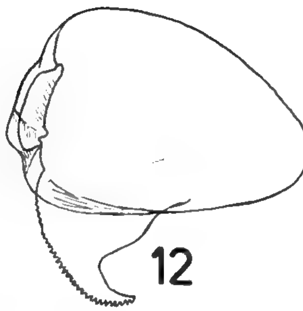
Text figs. 11-14. *Austraeolis westralis* sp. nov.
11. Liver system.
12. Jaw.
13. Radular tooth.
14. Genital organs.

Text figs. 15-18. *Austraeolis benthicola* sp. nov.
15. Right lateral view of holotype.
16. Jaw.
17. Radular tooth.
18. Ectal male genital tract.

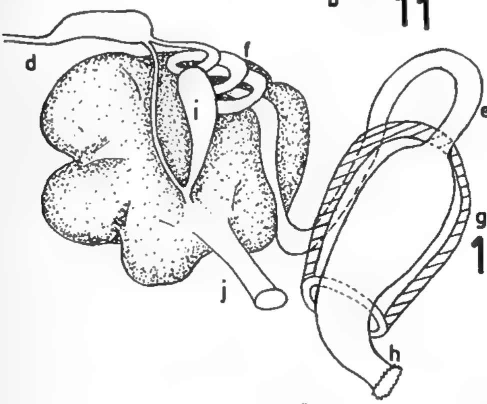
R. Burn delin.



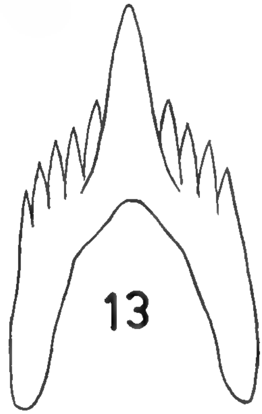
11



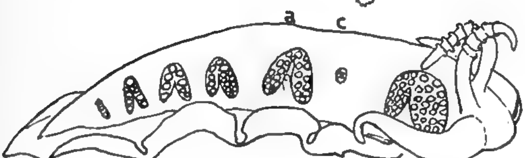
12



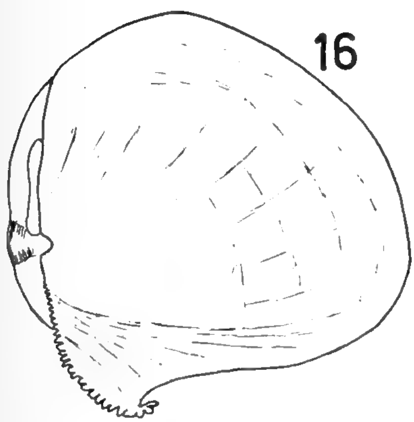
14



13



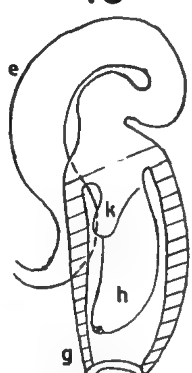
15



16

17

18



The body (fig. 15) is broad, high and attenuated behind. The foot corners are tentaculiform and large, the tentacles very wide at the base and sharply tapered, the rhinophores very long with five annulae in the distal half. Foot very broad; margins 1-1.5 mm. wide are present along each side of the body and extend behind the body for 2-3 mm. Cerata in five arches and one single row each side. Right liver with 4-5 irregular series of cerata in the broad anterior limb and two series in the slender posterior limb. The arches are symmetrical posteriorly. The shape of the cerata is not known. The genital aperture (*b*) lies below the anterior limb of the right liver, the anus (*a*) opens in the apex of the first arch posterior liver right side, the renal pore (*c*) at the second-third of the interhepatic space.

The brown jaws (fig. 16) are 3.7 mm. long, ovate in shape with a vertical flange on the anterior edge. Masticatory borders short, with 30 irregularly rounded denticles. Radula with 28 long slender teeth (fig. 17), each with a large tapering cusp and 2-3 denticles each side.

The ectal vas deferens (fig. 18, *e*) is dilated and as in *A. ornata* and *A. westralis,* it passes through the muscular penial sheath before looping to enter the base of the penis. The penis (*h*) is conical and rather short; its tip has a shallow rim on one side that forms a lip upon which the vas deferens opens. A large tongue-like flap (*k*) hangs beside the penis base within the sheath (*g*).

Discussion: Wide foot margins, ovate jaws, slender radular teeth and the apicial rim of the penis are the special characteristics of *A. benthicola,* which distinguish it from both *A. ornata* and *A. westralis.* Its habitat suggests that it will remain a very rare species.

This is the first deep-water eolid to be recorded from Australia. The specific name refers to its benthic habitat.

REFERENCES

ALDER, J., and A. HANCOCK, 1844. Description of a new genus of nudibranchous Mollusca, with some new species of *Eolis*. *Ann. Mag. Nat. Hist.*, 13:161-166, pl. 2.

———, 1845-1855. *A Monograph of the British Nudibranchiate Mollusca*, Pts. 1-7, 438 pp., 84 pls., London (Ray Society).

ALLAN, J., 1950. *Australian Shells.* xix + 470 pp., 44 pls. Georgian House, Melbourne.

ANGAS, G., 1864. Descriptions d'espèces nouvelles appartenant à plusiers genres de Mollusques Nudibranches des environs de Port Jackson, etc. *J. Conchyliol.*, 12:43-69, pl. 4-6.

BABA, K., 1949. *Opisthobranchia of Sagami Bay.* 194 + 7 pp., 50 pls. Iwanami Shoten, Tokyo.

———, 1959. A new record of an interesting species, *Embletonia gracile* Risbec, from Japan. *Publ. Seto Mar. Biol. Lab.*, 7:335-336, pl. 29.

———, 1963. Anatomy of *Embletonia gracilis paucipapillata* n. ssp. from Osaka Bay, Japan. *Ibid.*, 11:399-402, pl. 17.

BERGH, R., 1884. Report on the Nudibranchiata. *Rep. Sci. Res. Challenger, Zool.*, 10:1-154, pl. 1-14.

BURN, R., 1957. On some Opisthobranchia from Victoria. *J. Malac. Soc. Aust.*, 1:11-29, pl. 1-3.

———, 1962. Descriptions of Victorian Nudibranchiate Mollusca, etc. *Mem. Nat. Mus., Melb.*, 25:95-128.

———, 1963. Descriptions of Australian Eolidacea, I, The genera *Catriona* and *Herviella*. *J. Malac. Soc. Aust.*, 7:12-20.

———, 1964. Ibid., 2, The genera *Nossis, Eubranchus, Trinchesia* and *Toorna*. *Ibid.*, 8:10-22.

DAKIN, W., 1952. *Australian Seashores.* 12 + 372 pp., 100 pls. Angus and Robertson, Sydney.

LEMCHE, H., 1964. *Eubranchus* Forbes, 1838 (Gastropoda): Proposed designation under the Plenary Powers of a type species, etc. Z.N. (S) 1102. *Bull. Zool. Nom.*, 21:40-44.

MARCUS, E., and E., 1958. Opisthobranchia aus dem Schill von Helgoland. *Kieler Meeresforsch.*, 14:91-96, pl. 18.

RISBEC, J., 1928. Contribution à l'étude des nudibranches Néo-Calédoniens. *Faune Colon. Franc.*, 2:1-238, pl. 1-12, A-D.

———, 1953. Mollusques nudibranches de la Nouvelle Calédonie. *Faune Un. Franc.*, 15:1-189.

RISSO-DOMINGUEZ, C., 1964. Notes on the Facelinacea, 2. On the systematic position of *Hervia serrata*, etc. *Beaufortia*, 10:222-238.

THE SEPARATION AND IDENTIFICATION OF SMALL JUVENILES OF THE SPECIES *VELACUMANTUS AUSTRALIS* AND *PYRAZUS EBENINUS* (GASTROPODA: POTAMIDIDAE)

By Wm. H. EWERS* and C. R. ROSE*

Pls. 5-7.

Velacumantus australis (Quoy and Gaimard) and *Pyrazus ebeninus* (Bruguière) are often found living together in estuarine lakes (O'Gower, 1964). These two species are closely related and in the past have been placed in the same genus. Difficulty has been experienced in separating and identifying the small juveniles of these two species (Ewers, 1963).

As a result of a careful examination of a range of juveniles of both species, collected at various times during the past year from the same area of Lake Burril, and comparison with larger juveniles, the small juveniles of these two species can now be separated and identified.

The diagnostic characteristics of the juveniles of the two species are as follows:

1. *Ridges at bottom of growing whorl*

When viewed end on, *P. ebeninus* has two marked ridges at the bottom of the growing whorl. The region between these two main ridges is smooth, and of uniform colour. *V. australis* has a number of smaller

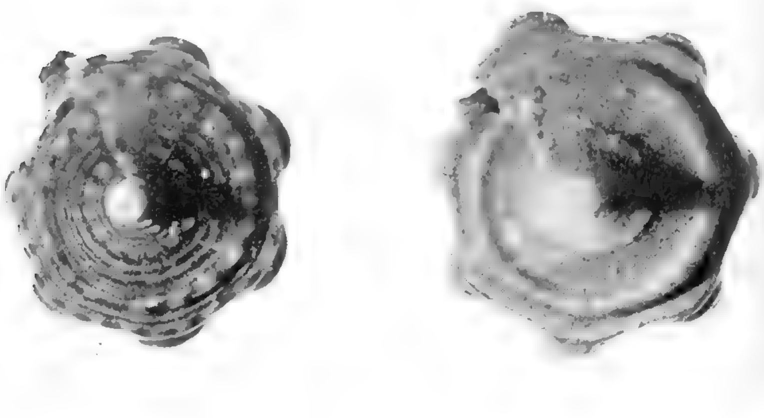


PLATE 5

Juveniles of the two species viewed end on to show differences in shell sculpture: left, *Velacumantus australis;* right, *Pyrazus ebeninus.*

* Department of Zoology, The Australian National University, Canberra.

ridges in addition to the two main ones and these are often varigated with areas of light and dark, which gives the ridges of the growing whorl a spotted appearance (Pl. 5).

These differences are most obvious when viewed under magnification (x8).

2. *Angle of the spire*

The angle of the spire of *V. australis* is greater than that of *P. ebeninus,* i.e., *P. ebeninus* is long and thin in comparison with *V. australis.* Juveniles are readily sorted on this basis, but without confidence. The angle of the spire of samples of all age groups of both species was measured in the following way:

Specimens were placed on photographic plates which were then exposed to a point source of light several feet above them and enlarged prints were made of the resulting silhouettes. The angle of the spire was then ruled in and measured with a protractor. In older snails the whorls at the top of the spire are usually worn and care was taken when ruling lines to make them coincide with the edges of the unworn anterior whorls.

The results are summarised in Table 1. The ranges of the angles of the spire overlap considerably. However, the differences between the two species are highly significant (in both cases the probability is less than .005). The standard deviations of the *P. ebeninus* samples are considerably less than those for the *V. australis* samples. That is, the range of angles in *P. ebeninus* is smaller than that of *V. australis.*

3. *Colour*

The growing whorl of juvenile *P. ebeninus* tends to be a light brown colour while in *V. australis* it tends to be darker brown or grey. This difference is not constant, and when specimens are wet the colours of both species are very variable. Dry specimens can be sorted on the basis of colour, but one does not feel very confident about it.

4. *Sculpturing on the shell*

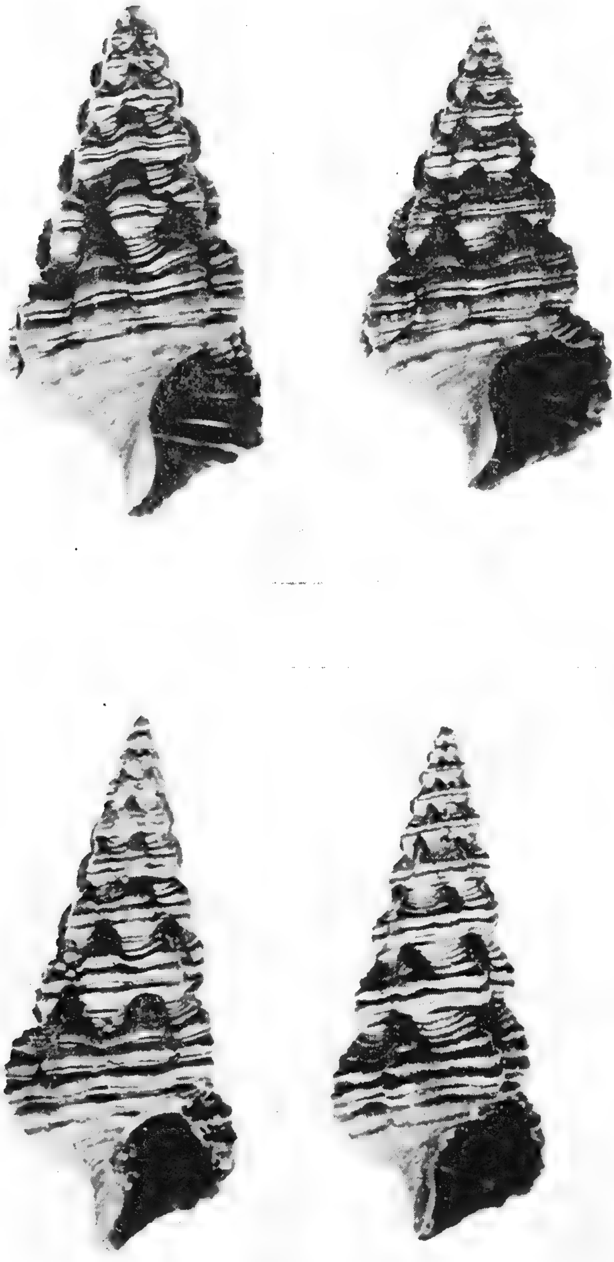
When unworn shells of both species are examined under a dissecting microscope, in good light, differences in the spiral striae can be seen (Pl. 6).

Both species have 6 main ridges or spiral striae to each whorl, but in the case of *V. australis* there are one or two minor ridges between the six major ones. These features are perhaps best seen by low power examination of impressions of the shells in plasticene (Pl. 7).

TABLE 1

	V. australis			*P. ebeninus*		
Juveniles 11-15mm.	N 50	avg. angle 37.92 ± 2.79	range 31 - 45	N 51	avg. angle 31.72 ± 1.84	range 28 - 35
Larger specimens (all ages)	47	34.34 ± 4.28	25 - 44	41	26.44 ± 2.56	21 - 33

Data on the angle of the spire of the two species (N = sample size).



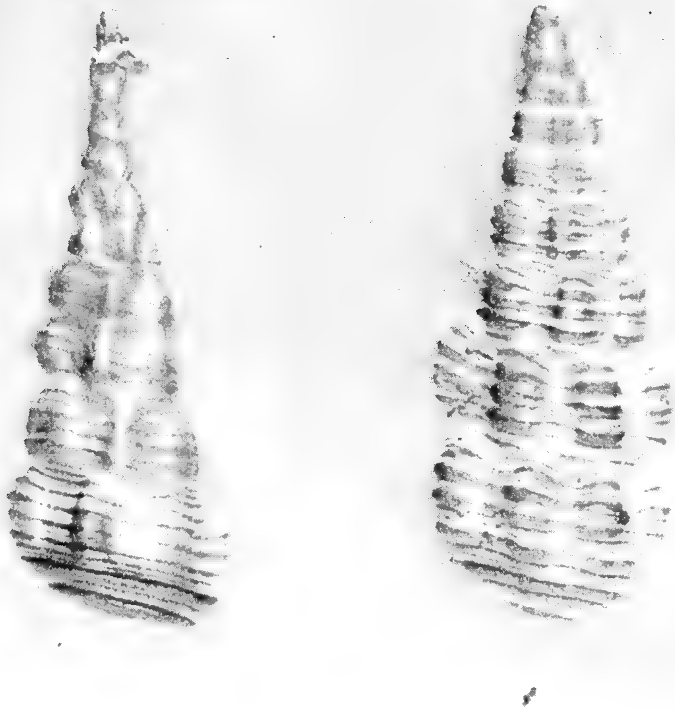


PLATE 7

Plasticene impressions of large juveniles of *P. ebeninus* (left) and *V. australis* (right). Note differences in shell sculpture, especially the minor ridges in *V. australis.*

REFERENCES

EWERS, W. H., 1963. Some observations on the life cycle of *Velacumantus australis* (Quoy and Gaimard) (Gasteropoda: Potamididae). *J. Malac. Soc. Aust.,* 7:62-67.

O'GOWER, K., 1964. Locomotion, dispersal and distribution of gastropod molluscs. *Aust. Nat. Hist.,* 14:391-394.

PLATE 6

Juveniles of the two species. Note differences in the angle of the spire and differences in sculpture. The knobs on *V. australis* (top) are larger than those of *P. ebeninus* (bottom) and in *V. australis* the minor ridges are more pronounced.

SOME PELAGIC MOLLUSCS AND ASSOCIATED ANIMALS IN SOUTH-EASTERN AUSTRALIAN WATERS

By ISOBEL BENNETT*

Pls. 8-13.

Offshore, along the coast of New South Wales, there is a warm southward-flowing current in which many of the pelagic animals of the high seas are to be found. Each year, during the summer months (October to February), the prevailing winds are from the north-east, and when these have been blowing strongly and continuously for several days at a time, many oceanic species are blown shorewards, and on occasions the coastline may be strewn with dead or dying animals of different kinds.

The greater bulk of these belong to the Cnidarian Order, Siphonophora, with the Portugese Man-of-war, *Physalia utriculus* Eschscholtz, 1829, being the most numerous, so much so that at times it causes havoc among the swimmers on surf beaches. In some years its relative, the By-the-wind Sailor, *Velella lata* Chamisso and Eysenhardt, 1821, also occurs in large numbers, and less frequently a third species, *Porpita pacifica* Lesson, 1826, is found among the flotsam and jetsam along the ocean tidelines. On January 22nd, 1964, this last species formed the bulk of the animals being cast up on some Sydney beaches, but this is an unusual occurrence.

Nearly always associated with one or more of the above are three or four species of molluscs which prey upon them, the two most obvious being the purple snails belonging to the genus *Janthina*†. The other two species are pelagic nudibranchs, *Glaucus* and *Fiona*.

Bayer (1963) has described a similar association along the eastern coast of Florida where the animals are blown ashore from the Gulf Stream. Morton (1954) records the association found in the Benguela Current off the coast of south-west Africa. Bieri (1961) has suggested a correlation between food supply, seasonal occurrence, and reproductive cycle in *Velella lata,* which could possibly have the same kind of significance in other members of this pelagic community.

CLASS GASTROPODA

SUB-CLASS PROSOBRANCHIA

ORDER MESOGASTROPODA

FAMILY JANTHINIDAE

Janthina janthina (Linné).

Helix janthina Linné, 1758, *Syst. Nat.*, 10 ed., 1, p. 772.

Janthina violacea Röding, 1798, *Mus. Bolten.*, 2, p. 75.

Janthina planospirata A. Adams and Reeve, 1850, *Zool. Voy. Samarang*, p. 54, pl. 11, fig. 10.

* School of Biological Sciences, University of Sydney.

† This name is spelt with an initial "J" in the original publication, although many modern workers use "I", presumably following Laursen's (1953) Monograph.

Allan (1950) records four species of the family Janthinidae from New South Wales waters, Iredale and McMichael (1962) record five species, and Macpherson and Gabriel (1962) refer to two definite species from Victorian waters, and mention other names recorded in the literature. Two species are figured in May's (1958) list for Tasmania.

Laursen (1953) placed all the then known species of the genus *Janthina* into the synonymy of five species, using radula teeth and ontogenetic conditions of the animals themselves rather than shell pattern to differentiate them. On the basis of his classification, all five species are distributed throughout the Pacific, Indian and Atlantic Oceans. Laursen has reduced all viviparous animals with trochoid shell to the species, *Janthina janthina* (Linné). In all other species the shell is globose, and the animals oviparous.

During the last 20 years, the animal most often collected in New South Wales waters by the author, and the shell which also forms the bulk of the Australian Museum collection, is that which has generally been referred to as *J. violacea* Röding, 1798. In making a comparison of the shells in the collection with Laursen's description, no significant difference could be found, and the species is definitely viviparous (Pl. 8, figs. 2, 3, which is a photograph of an animal washed ashore at Bondi, N.S.W., on January 4th, 1965).

Bayer (1963) and Wilson and Wilson (1956) have given a number of interesting facts regarding the biology of this species.

Very large shells of this species in the Australian Museum collection were blown ashore at Lord Howe Island in October-November, 1950. The largest measured 46.5 mm. in diameter and 39.5 mm. in height.

When these animals are blown ashore on ocean beaches they are, in most instances, bashed by the surf and the float is seldom found intact. On January 14th, 1965, however, over 300 animals were collected alive, all with the float attached, on the western shore of Botany Bay, where they had been gently floated on to a surfless beach (Pl. 8, fig. 1). *Physalia, Velella* and *Porpita,* and the nudibranch, *Glaucus,* were collected with them.

Janthina prolongata Blainville.

Janthina prolongata Blainville, 1822, *Dict. Sci. Nat.* 24, p. 155.

Janthina globosa Swainson, 1826, *Zool. Illus.,* 2, pl. 85 (non *globosa* Blainville, 1825).

The second conspicuous species occurring along the coast, a very globose shell of uniform violet colour, often with a mass of egg capsules along the float, agrees with Laursen's diagnosis of *J. prolongata.* (Pl. 9, fig. 1; Pl. 10, fig. 1.)

Janthina exigua Lamarck.

Janthina exigua Lamarck, 1816, *Ency. Méth.* (Vers), pl. 456, figs. 2a and b, Liste, p. 12.

Janthina capreolata Montrouzier, 1859, *J. Conchyliol.,* 8, p. 375.

Shells belonging to this species have previously been referred to the genus *Iodina* Mörch, 1860, *J. Conchyliol.,* 8, p. 282. Shells in the Australian Museum collection are strongly sculptured with V-shaped ridges, the apex of the V's forming a peripheral furrow. (Pl. 9, fig. 2.)

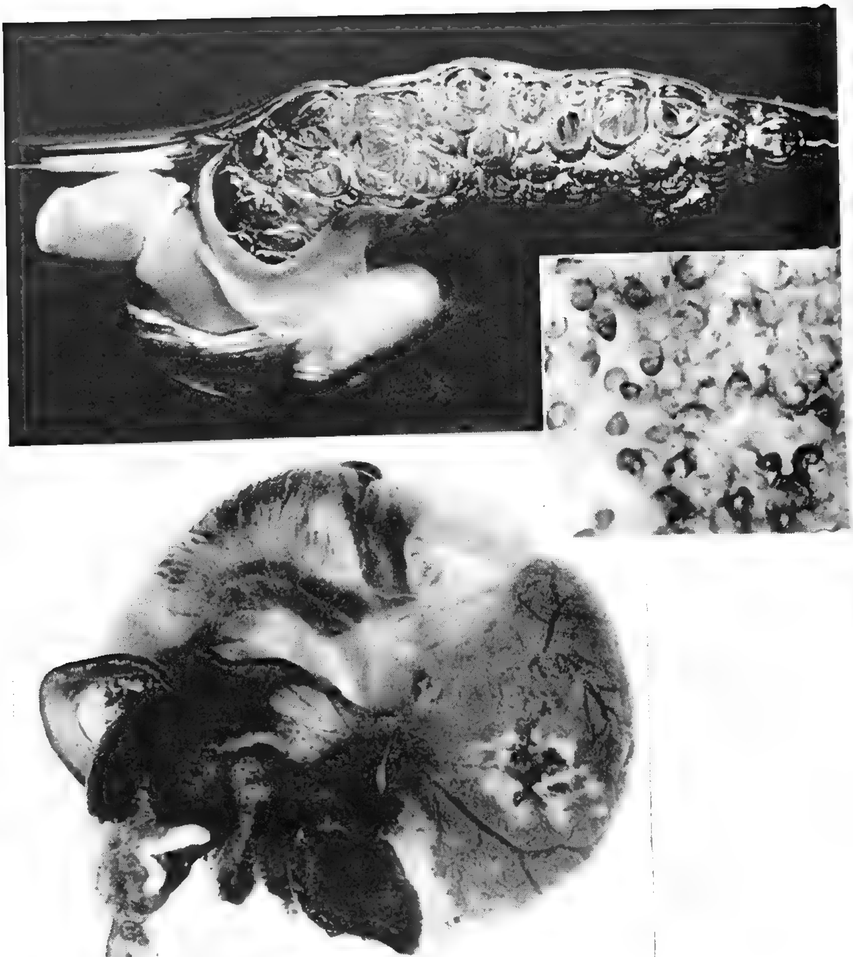


PLATE 8

(1) *Janthina janthina*—living animal with float attached, washed ashore Botany Bay, N.S.W., January, 1965.

Photograph: Mr. Justice F. G. Myers.

(2) *J. janthina*—animal removed from shell, washed ashore Bondi Beach, N.S.W., 4th January, 1965. The light patch in the lower right segment of the animal marks the region where the outer layer of tissue was removed to take the inset photo.

(3) *J. janthina*—veliger larvae with well-developed shells were present in the ovary in large numbers. X 20.

Photographs: Dept. of Illustration, University of Sydney.

Janthina umbilicata D'Orbigny.

Janthina umbilicata D'Orbigny, 1840, *Voy. Amér. Mérid.* No. 319.

Janthina nitida Adams, 1869, *Proc. Zool. Soc. Lond.*, 1868, p. 620.

Laursen has referred this species to the synonymy of *J. exigua* Lamarck. It has not been possible to obtain living or preserved animals with floats and egg capsules to compare these with Laursen's description, but in all the specimens in the Australian Museum collection referred to this species, the shell is different to that of *J. exigua,* being much smoother. Although there is one record of occurrence as far south as Bermagui in southern New South Wales, the greater number of shells in the collection are from warmer northern waters of the coast and islands surrounding the Coral Sea.

FAMILY RECLUZIIDAE

Recluzia rollandiana Petit.

Recluzia rollandiana Petit, 1853, *J. Conchyliol.*, 4, pp. 119-120, pl. 5, fig. 2.

The small collection of shells in the Australian Museum consists of two species belonging to this family, one of which, a high spired form, was named *R. hargravesi* Cox, from Port Stephens, N.S.W. This could be synonymous with the species recorded from the Indian Ocean and commonly known as *R. johnii* Chemnitz. However, it has not been possible to determine the correct name of the latter.

The second species, in which the shell is more swollen with a relatively lower spire and produced columella, appears identical with Petit's *R. rollandiana* and the animal illustrated (Pl. 11, fig. 1) is the first record of this species from New South Wales.

There are also specimens of this shell in the Australian Museum from Catherine Hill Bay, N.S.W., and Caloundra, Queensland. The name *R. lutea* Bennett, 1840 (*Narr. Whaling Voy.* 2, p. 63 and p. 298), has sometimes been used for this species but the description is so meagre as to make its identity uncertain.

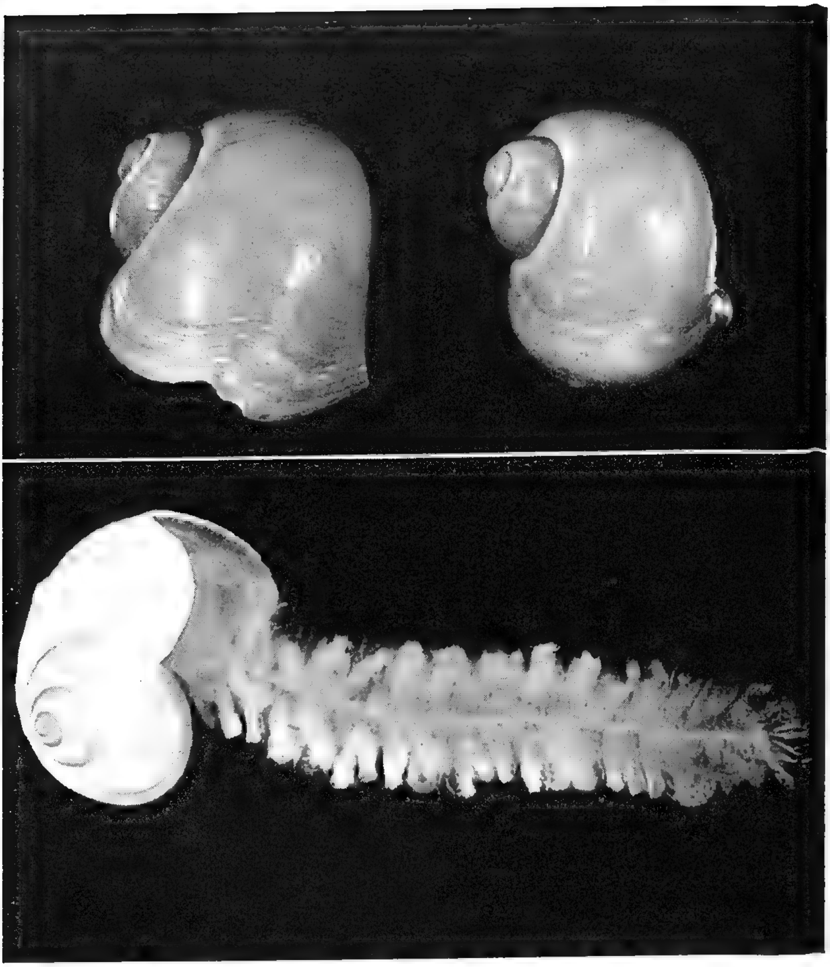


PLATE 9

(1) *Janthina prolongata*—shells washed ashore, Long Reef, Collaroy, N.S.W., January, 1964.

Photograph: Mr. Justice Myers.

(2) *Janthina exigua* (from the North Pacific)—with its unmistakable long narrow float covered with egg capsules. Veligers have already been freed from the distal capsules. (31°06′ N. 130°06′ W. 18th July, 1963.)

Photograph: Mr. Justice Myers.

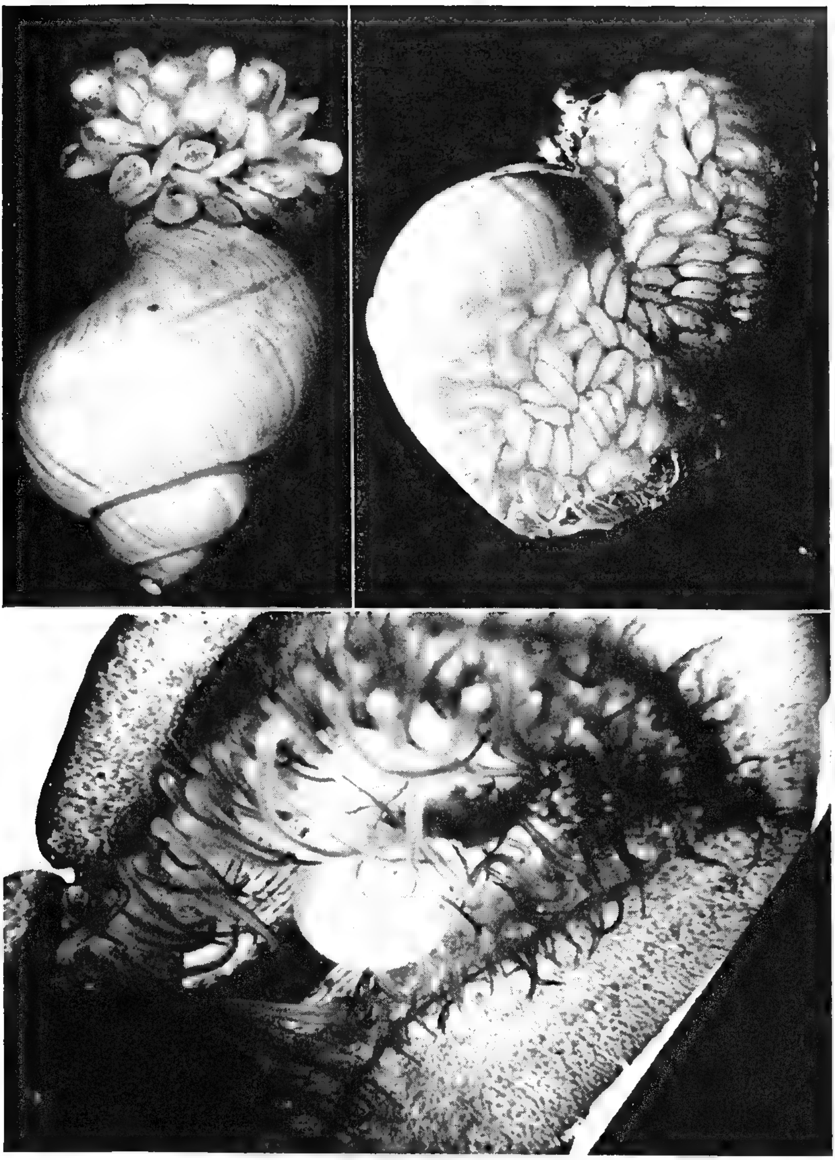


PLATE 10

(1) *Janthina prolongata*—living animal with float, Sydney, N.S.W.
Photograph: Mr. Justice Myers.

(2) *Janthina pallida* with its float and egg capsules which resemble those of *J. prolongata*. (31°06′ N. 130°06′ W. 18th July, 1963.)
Photograph: Michael Hadfield.

(3) *J. pallida*—small animal (shell 1 cm.) without float, as it occurred on the underside of *Velella* in north Pacific waters, July, 1963.
Photograph: Paul Schroeder.

SUB-CLASS OPISTHOBRANCHIA

ORDER NUDIBRANCHIA

SUB-ORDER AEOLIDACEA

FAMILY FIONIDAE

Fiona pinnata Eschscholtz.

Fiona pinnata Eschscholtz, 1831, *Zool. Atlas,* 4, p. 14, pl. 19, fig. 1.
4, p. 14, pl. 19, fig. 1.

This species occurs sporadically along the coast of New South Wales. The author has never taken it as a free-swimming animal, but always on some floating object, usually one which has numbers of stalked barnacles, *Lepas spp.* attached to it. The slightly-coiled egg masses were found on bottles, cuttle bones and logs along with the adult *Fiona.*

FAMILY GLAUCIDAE

Glaucus atlanticus Forster.

Glaucus atlanticus Forster, 1777, *Voy. round World,* p. 49.

Glaucus lineatus Bergh, 1867, *K. Danske Vidensk. Selsk.* (5), 7, p. 147.

This species has been recorded from time to time in the Australian literature as *G. lineatus.* Mr. Robert Burn, who is systematically reviewing the Australian nudibranch fauna considers that this is merely the Pacific form of the Atlantic species, *G. atlanticus.*

Unlike *Fiona, Glaucus* is a free-living animal, living upside down on the surface film of the water. During heavy north-easterly weather in the last week of December, 1964, and the first week of January, 1965, enormous numbers of this animal were washed ashore on surfing beaches in the vicinity of Sydney. Several hundred were collected in a very short time on Warriewood Beach. They were accompanied by *Physalia* and *Janthina janthina.* In April, 1962, about 12 miles off Sydney, a number of specimens were caught with a dip-net in the surface waters where they were present in large numbers together with *Physalia* and *Velella.* Specimens kept alive in the laboratory for several days all laid strings of eggs.

CLASS CEPHALOPODA

SUB-CLASS COLEOIDEA

ORDER DECAPODA

FAMILY SPIRULIDAE

Spirula spirula (Linné).

Nautilus spirula Linné, 1758, *Syst. Nat.,* 10 ed., 1, p. 710.

The characteristic shells of *Spirula,* often with numbers of the small stalked barnacle, *Lepas pectinata* Spengler attached, are cast up sporadically along the coast, together with the animals mentioned above.

* It would be useful if an international decision could be made regarding the correct name by which this community should be designated. American writers use the term "Neuston" (presumably following P. S. Welch, *Limnology,* McGraw Hill, N.Y., 1952). P. M. David (*Endeavour,* 24, no. 92, May, 1965) uses the term "Pleuston" after A. I. Savilov (*Dokl. Ak. Nauk. S.S.S.R.,* 110, 3, 1956). From its Greek derivation (*pleustikos*—ready for sailing) this latter would seem an appropriate term, but unfortunately Welch specifically uses it for higher plants only.

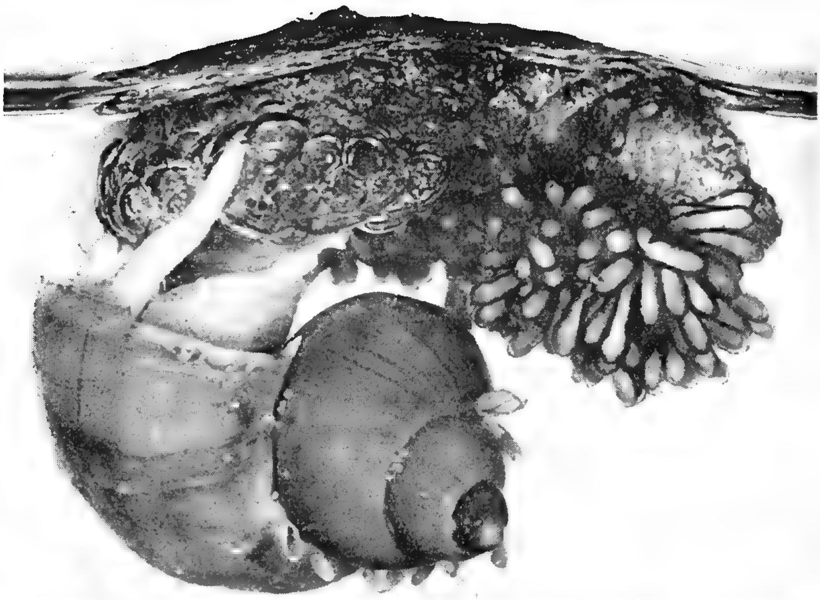
NOTE ON THE OCCURRENCE OF A SIMILAR PELAGIC COMMUNITY IN THE NORTH PACIFIC OCEAN

In July, 1963, the author, whilst acting as a faculty member on board Stanford University's research vessel *TE VEGA*, noted the same kind of floating community* in northern Pacific waters about 300 miles west of the coast of California (Lat. 31° N., Long. 125° to 140° W.). Large *Velella* (ca. 9 cm. along the float) were first sighted on July 15th, the sea surface temperature being 18°C. For the next 36 hours the ship sailed through *Velella*, all the specimens caught with dip net being large and a very beautiful deep blue in colour. By the time the ship had reached longitude 127°31′ W. it was found that almost all animals caught had from one to five small *Janthina pallida* Thompson, feeding on the undersurface among the tentacles. It was also noted that none of these *Janthina* (some of the shells were up to 1 cm. in length) had begun to secrete floats. Some of the *Velella* also had small powder-blue stalked barnacles, *Lepas fascicularis* Ellis and Solander, attached to their floats, and on some the small blue pelagic crabs, *Planes cyaneus* Dana, were clinging. On others again, the nudibranch, *Fiona pinnata* Eschscholtz, was found. Floating objects such as fronds of seaweeds or pieces of wood were also picked up with colonies of larger lepadid barnacles, among which the small *Planes* were very numerous, together with varying numbers of *Fiona*. When this nudibranch occurred with these barnacles the colour was distinctly brown, presumably from the barnacles on which the animal was feeding. When *Fiona* occurred on *Velella* it was always blue in colour.

By July 18th, the size of individual specimens of *Velella* being caught had decreased considerably, and it was noted that most animals captured had one or more *Fiona* on them, and these appeared to keep to the upper surface of the *Velella*, but there were no *Janthina*. Several much larger *J.pallida*, now with floats, and several with egg capsules, were seen, and a second species, *Janthina exigua* Lamarck, was also noticed to be present in large numbers. It was significant, however, that this smaller species was not found on *Velella*, but always free-floating. Tiny individuals ½ to 1 mm. in size had no float, but those from 2 to 3 mm. had already begun to secrete them. This was a distinctly different behaviour pattern from that of the larger species. The float was quite different in size, being long and narrow, and the egg capsules of mature individuals showed serial development along the float, from those nearest the animal with over 200 small white eggs to dark-coloured ones with shelled veligers clearly visible (Pl. 9, fig. 2). Several were hatched out whilst under observation in the ship's laboratory.

By late afternoon of the same day, living *Velella* were rarely seen, but large numbers of bare floats were taken, some with one to three or four *Fiona* attached, and nearly all bearing the characteristic coiled egg masses of the nudibranch (Pl. 12, fig. 2). A few small specimens of *Physalia, Porpita* and *Glaucus* were seen, but their occurrence was sporadic.

By July 20th, at longitude 135° W., the *Velella* were no longer being seen, although large numbers of minute *Janthina exigua* continued to be seen in the surface waters for the next two days.



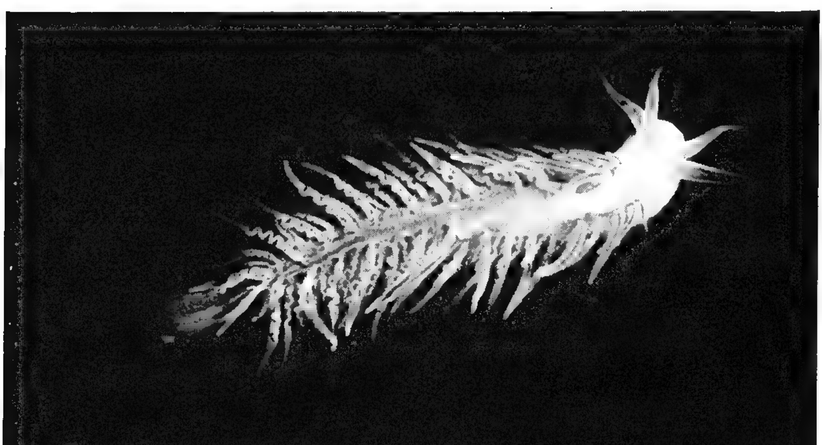


PLATE 11

(1) *Recluzia rollandiana*—living animal with its float and egg capsules, Minnie Waters, northern N.S.W., April, 1964.

Photograph: Anthony Healy.

(2) *Fiona pinnata*—living animal, removed from a floating, barnacle-encrusted log, Collaroy Beach, N.S.W., April, 1964.

Photograph: Mr. Justice Myers.

PLATE 12

(1) A mass of *Fiona pinnata* feeding on barnacles, *Lepas anatifera*, on floating log washed ashore, Collaroy Beach, N.S.W., after a heavy storm, April, 1964.

Photograph: Mr. Justice Myers.

(2) The slightly coiled egg masses of *Fiona pinnata* on *Velella* floats. (31°06′ N. 130°06′ W. 18th July, 1963.)

Photograph: Michael Hadfield.

ACKNOWLEDGEMENTS

I should like to acknowledge the help of Dr. D. F. McMichael, of the Australian Museum, for his critical reading of this manuscript, and Miss E. C. Pope, also of the Australian Museum, for checking the identifications of stalked barnacles. I should also like to thank the photographers whose names appear below the respective plates.

REFERENCES

ALLAN, J., 1950. *Australian Shells.* Georgian House, Melbourne.

BAYER, F. M., 1963. Observations on Pelagic Mollusks associated with the Siphonophores *Velella* and *Physalia. Bull. Mar. Sci. Gulf and Caribb.*, 13, No. 3.

BIERI, R., 1961. Post-larval Food of the Pelagic Coelenterate, *Velella lata. Pacif. Sci.*, 15 (4).

DAKIN, W. J., I. BENNETT and E. POPE, 1952. *Australian Seashores.* Angus & Robertson, Sydney.

GANAPATI, P. N., and D. V. SUBBA RAO, 1959. Notes on the Feeding Habits of *Ianthina janthina* Linnaeus. *J. Mar. Biol. Ass. India*, 1, (2).

LAURSEN, D., 1953. The genus *Ianthina. Dana Rep.*, 38.

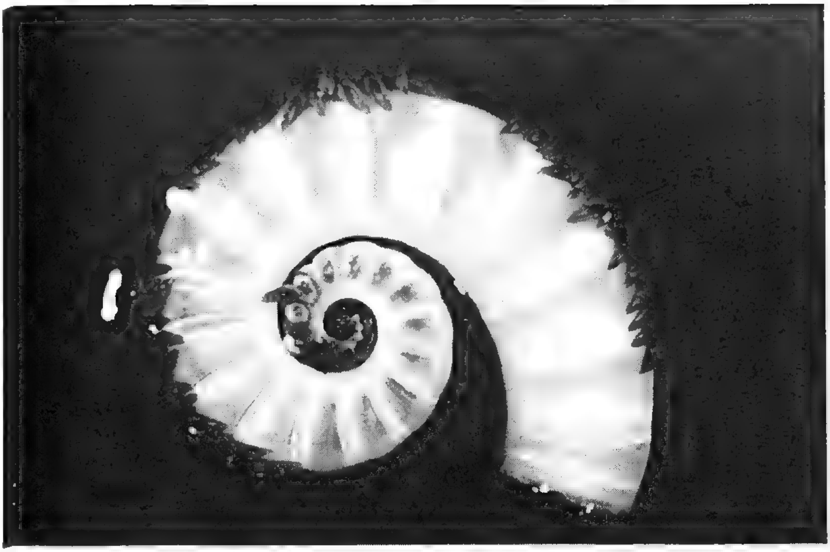
IREDALE, T., and D. F. McMICHAEL, 1962. A Reference List of the Marine Mollusca of New South Wales. *Mem. Aust. Mus.*, 11.

MACPHERSON, J. H., and C. J. GABRIEL, 1962. *Marine Molluscs of Victoria.* Melbourne University Press and the National Museum of Victoria, Melbourne.

MAY, W. L., 1958. *An Illustrated Index of Tasmanian Shells* (Revised ed., by J. Hope Macpherson). Government Printer, Hobart.

MORTON, J. E., 1954. The Pelagic Mollusca of the Benguela Current, Part 1. *Discovery Rep.*, 27.

WILSON, D. P., and M. A. WILSON, 1956. A Contribution to the Biology of *Ianthina janthina* (L.). *J. Mar. Biol. Ass. U.K.*, 35:291-305, 2 figs., pl. 1.



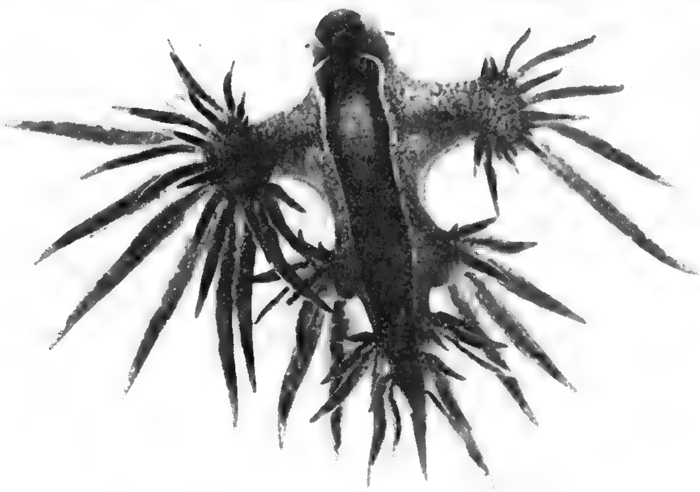


PLATE 13

(1) Shell of *Spirula spirula* with newly attached post-cyprid stages of *Lepas pectinata*. Washed ashore Lord Howe Island, May, 1964.
Photograph: Mr. Justice Myers.

(2) *Glaucus atlanticus*—undersurface of animal showing foot. Washed ashore on a Sydney beach.
Photograph: Keith Gillett.

SAND, CONSIDERED AS AN ACCESSORY HABITAT FOR THE NERITES

By P. H. FISCHER*

The main environment for Nerites consists of rocks, where they bore individual holes, and of stones. But they sometimes occur on or in the sand, either near rock or even far away from any rocky or stony formation. In the latter alternative, an adaptation to the sandy life is to be considered.

At Heron Island, Queensland, I have noticed that *Nerita albicilla* L. is capable of moving on the sand surface for a distance of two or three feet away from a rocky place. The trails on the sand may lead to individuals buried at little depth.

Nerita polita L. acts in the same manner. This species, particularly active and resistant, may be found on the sand, not only near its ordinary habitat, the rock, but much further away. On the sand flat, which lies on the north-eastern side of Heron Island, this species may be seen up to a distance of 300 metres from any rock. The trails it makes, at low tide, on the surface of the sand are often rectilinear, parallel as well as perpendicular to the shore line. These trails may spring from a hole in the sand, showing that the *Nerita* had buried itself at high tide, and had emerged and circulated at low tide.

Thus being essentially rocky creatures, the Nerites may venture on the sand, often very far away, and they seem to be preadapted to a burrowing life.

A little problem then occurs, that of their feeding. In ordinary conditions, the Nerites feed upon small algae growing on the surface of the rocks. But these algae are absent in the highest level of the sandy places where Nerites are occasionally located.

When Nerites venture too far away on the sand to be able to get back to their rocks, I suppose they feed on the sandy area, not at the same level where they are usually distributed, but at a lower level, on the greenish lower sand which is rich in algae.

On several occasions I saw, at low tide, *Nerita polita* reaching from the hole where they were buried in the upper white sand at high tide, to the greenish lower sand.

Although not having observed the feeding process itself, I think this may be a satisfactory explanation of the fact that Nerites may survive when they settle occasionally in this new environment—the sand.

* C/o Mr. R. Marmont, 56 Centennial Avenue, Lane Cove, N.S.W.

A NEW SUBSPECIES OF *VOLUTOCONUS GROSSI* (IREDALE) (GASTROPODA: VOLUTIDAE) FROM NORTH QUEENSLAND

By DONALD F. McMICHAEL*

Col. Pl. 14.

Since last writing on the genus *Volutoconus* Crosse (McMichael, 1960), a number of additional specimens from known populations of *Volutoconus grossi* (Iredale) have been collected along the eastern Australian coast. Among these are several specimens from 60 to 70 fathoms from off Cape Moreton, southern Queensland, and off Coff's Harbour, northern New South Wales (Pl. 14, top left). An additional specimen is in the collection of T. A. Garrard, from 40 fm. off Port Macquarie. Allan (1956) recorded specimens from 35 fm. off Wooli. This suggests that a number of distinct populations, geographically restricted, and living in varying depths exist, but many more specimens are required to plot the species distribution precisely. All these southern shells are similar in shell morphology, and agree with the specimen figured by Allan (1956) except that the spire is not so drawn out as her figure suggests. A juvenile shell from off Cape Moreton, presented to the Australian Museum by N. J. Berrie, is of interest in that it bears fine radial ribs, similar to those recorded for *Volutoconus coniformis* (Cox) (McMichael, 1960). This specimen also shows that the central projecting papilla of the protoconch nucleus is similar in structure to the *calcarella* of the Scaphellinae, tribe Scaphelloides, as illustrated by Pilsbry and Olsson (1954). A similar calcarella is evident in live taken specimens of this species from south of Fraser Island, from off Yeppoon, and off Townsville, and also in the live taken specimen of *Volutoconus hargreavesi* (Angas) from 23 fm. north of Bezout Island, Dampier Archipelago, collected by the Hawaiian-West Australian Expedition in 1960 (see photograph in Weaver, 1960). Allan (1956) and Abbott (1958) both commented on the sharp spine-like papilla, but did not recognise it as a calcarella. The significance of this structure from the taxonomic point of view is uncertain since *Volutoconus* does not seem to be related in anatomy or radular structure to the Scaphelloides.

The holotype of *V. grossi* (Pl. 14, centre) is a beach-worn shell from Caloundra, Queensland. It is more high spired than the southern populations, in this feature resembling the "Tin Can Bay" shells, but it is much broader and heavier than the latter. It seems likely therefore that an as yet undiscovered population from which the holotype is derived lives on the continental shelf somewhere off Caloundra. Hundreds of specimens of the "Tin Can Bay" population were collected by scallop fishermen a few years ago (Pl. 14, top right). A series of these shells was illustrated by

* Curator of Molluscs, The Australian Museum, Sydney.

Field (1964) and the statement was made that they came from 27 to 33 fm. on a coral-shell bottom. Other specimens are localised as from 15 to 30 fm. The exact locality is Wide Bay, south of Fraser Island, Queensland, not Tin Can Bay which was the home port of the scallop boats.

I have previously described the ribbed protoconch of the Keppel Islands and Yeppoon population, the shell of which has not previously been illustrated (Pl. 14, bottom left). It is similar in shape to the northern New South Wales shells, but differs in having more distinctive white triangles and more well defined red bands (in these characters resembling the Fraser Island population). In my opinion, all these populations, although recognisably different, are not sufficiently distinct from each other to warrant subspecific nomination.

Some years ago, shells belonging to this species were dredged in shallow water (about 20 fathoms) from off Cape Bowling Green, just south of Townsville, Queensland. They were at once distinguished by the presence of four dark brown to black bands encircling the shell and were known locally as "black-banded *grossi*". This population was mentioned by Rippingale and McMichael (1961, p. 116), but the shells have not been illustrated previously to my knowledge. Specimens are now widely held by collectors and several Museums, mostly collected by Mr. T. Nielsen, of Yeppoon, to whom I am indebted for the presentation of the holotype specimen and of preserved animals for study.

This population differs significantly in appearance from the southern shells and appears to be separated from them by a wide distributional gap. I therefore propose to name it as a new subspecies.

Volutoconus grossi helenae ssp. nov.

(Pl. 14, bottom right).

Description: A population of *Volutoconus grossi* (Iredale) characterised by relatively small, slender shells, the maximum length about 87 mm., but specimens averaging 60 to 70 mm., maximum breadth about 30 mm., ratio of breadth to length averaging about 33% to 34%. Colour bright orange-red, overlain with numerous, discrete small white markings, roughly triangular, and circled with four discontinuous dark brown to black bands of varying breadth, situated (1) immediately anterior to the suture, (2) at the shoulder of the whorl or just below, (3) half way between the shoulder and the anterior end of the shell, and (4) just posterior to the basal fasciole. Of these, band (3) is the widest and most continuous in specimens examined so far. Spire elevated, protoconch orange, with numerous, well-defined, narrow, cream axial ribs, the nucleus bearing a prominent calcarella. Teleoconch with the early whorls bearing irregular axial ribs on the upper part of the whorls which become less prominent on the body whorl.

Animal (preserved in alcohol) cream, mottled with streaks and spots of purplish-red; siphon purplish-red above, cream below. Proboscis retracted in available specimens, long and muscular when dissected; tubular salivary glands long, complexly coiled together, without racemose glands (see Clench and Turner, 1964); Gland of Leiblin large, loosely bound with connective tissue. Radula with 31 teeth, measuring approximately 270 microns across the basal plate and 440 microns from the posterior edge of the basal plate to the anterior end of the central cusp; teeth similar to those of *V. grossi grossi* (see Abbott, 1958, text fig. 2).

Types and Type Locality: The holotype is in the Australian Museum,

no. C.68409, from 20 fms., south of Townsville, Queensland, collected T. Nielsen, October-November, 1964. It measures 62 mm. maximum length, 21 mm. maximum breadth.

Remarks: The subspecies is named for my wife, Helen, in appreciation of her help in many ways.

REFERENCES

ABBOTT, R. T., 1958. Notes on the anatomy of the Australian volutes, *bednalli* and *grossi*. *J. Malac. Soc. Aust.*, 2:2-7, pl. 1, text figs. 1, 2.

ALLAN, J., 1956. The reappearance of a rare Australian volute shell, *Amoria grossi* Iredale (Mollusca: Gastropoda), a new record for New South Wales. *Proc. Roy. Zool. Soc. N.S.W.*, 1954-55: 48-49, fig. 1.

CLENCH, W. J., and R. D. TURNER, 1964. The Subfamilies Volutinae, Zidoninae, Odontocymbiolinae and Calliotectinae in the Western Atlantic. *Johnsonia*, 4:129-180, pls. 80-114.

FIELD, L., 1964. Tin Can Bay V. grossi. *Hawaiian Shell News*, 12 (8):8.

McMICHAEL, D. F., 1960. Notes on some Australian Volutidae. *J. Malac. Soc. Aust.*, 4:4-13, pl. 1, text fig. 1.

PILSBRY, H. A., and A. A. OLSSON, 1954. Systems of the Volutidae. *Bull. Amer. Paleont.*, 35:275-306, pls. 25-28.

RIPPINGALE, O. H., and D. F. McMICHAEL, 1961. *Queensland and Great Barrier Reef Shells*. Jacaranda Press, Brisbane.

WEAVER, C. S., 1960. The "Hawaiian Scientific Expedition" collects rare Western Australian Volutes. *Hawaiian Shell News*, 8 (11):1, 3, figs. 1-6.

EXPLANATION OF PLATE 14.

All figures approximately half natural size.

Top Left: *Volutoconus grossi grossi* (Iredale). Off Coff's Harbour, N.S.W., 70 fm. A.M. No. C. 64927.

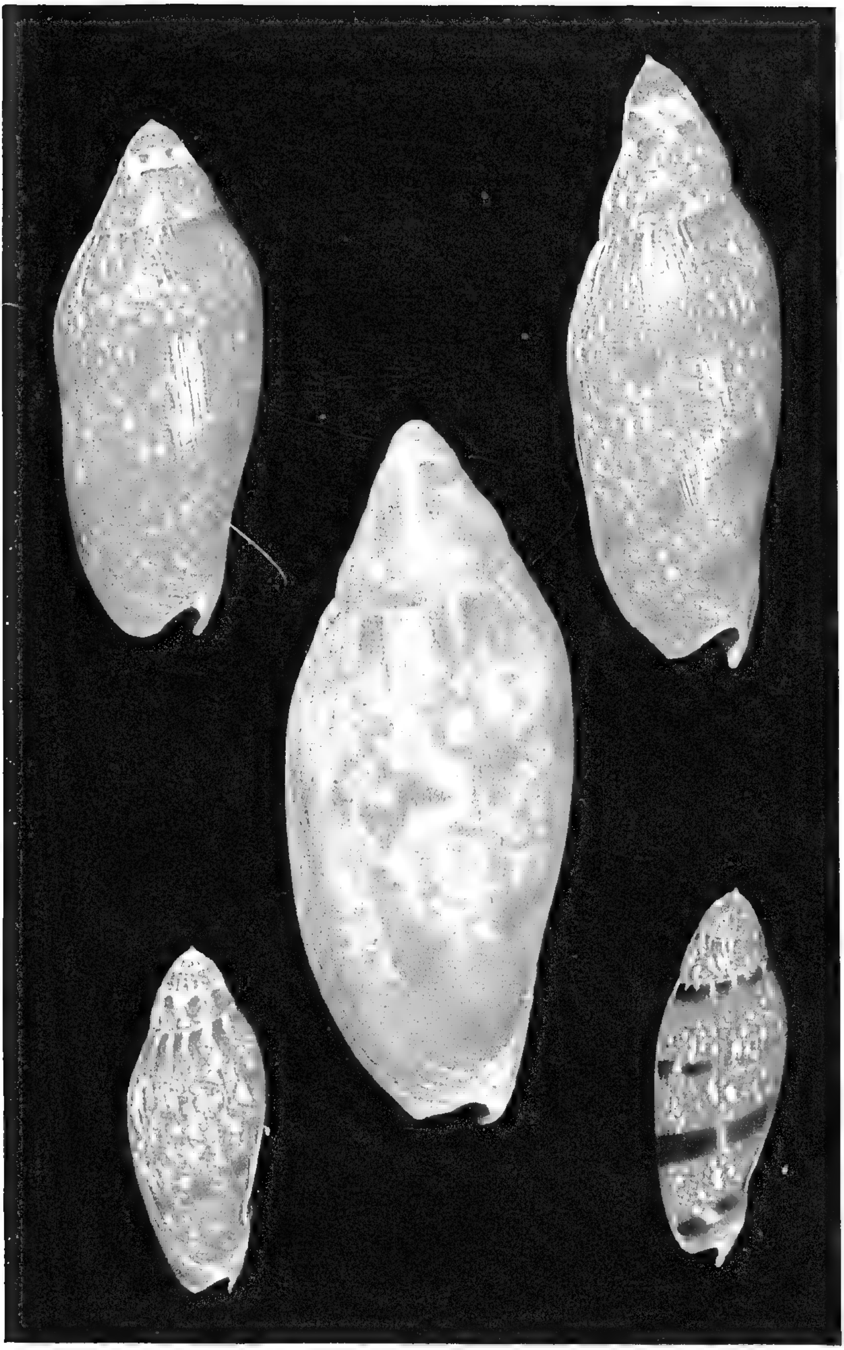
Top Right: *Volutoconus grossi grossi* (Iredale). Wide Bay, South of Fraser Is., Qld. A.M. No. C. 62517.

Centre: *Amoria grossi* Iredale. Holotype. Caloundra, Qld. A.M. No. C. 19213. [= *Volutoconus grossi grossi* (Iredale)].

Bottom Left: *Volutoconus grossi grossi* (Iredale). Off Keppel Is., Qld. A.M. No. C. 63184.

Bottom Right: *Volutoconus grossi helenae* McMichael. Holotype. Off Townsville, Qld., about 20 fm. A.M. No. C. 68409.

Colour blocks by courtesy Clifton S. Weaver in memory of William Stokes Weaver, 1943-1958. Printing by courtesy Keith Gillett.



MONOGRAPH OF THE GENUS *RHYNCHOTROCHUS* (PAPUININAE: CAMAENIDAE)

By WILLIAM J. CLENCH* and RUTH D. TURNER*

Pls. 15-22, text figs. 1-6.

This study is the third in a series covering the species in the subfamily Papuininae†. Species in the genus *Rhynchotrochus* are confined mainly to New Guinea and its satellite islands. Two species reach the Bismarck Archipelago and one occurs in northern Queensland.

Under *Specimens examined* we are following the naming of the three parts of New Guinea as used in the 1963 edition of the Atlas of the World published by the National Geographic Society, Washington, D.C.: West New Guinea (formerly Netherlands New Guinea), Northeast New Guinea (formerly Territory of New Guinea and German New Guinea), and Papua (formerly British New Guinea).

ACKNOWLEDGEMENTS

We are most grateful to the Curators of Mollusks in the institutions listed below for the loan of material in the Papuininae. In addition, we are indebted to Peter Dance, Lothar Forcart, Rudolph Kilias, D. F. McMichael and Adolph Zilch for photographs of the type specimens in their charge.

ABBREVIATIONS

AI	— Auckland Institute and Museum, New Zealand.
AM	— Australian Museum, Sydney.
AMNH	— American Museum of Natural History, New York.
BM	— Zoologisches Museum der Humboldt-Universität, Berlin, Germany.
BMNH	— British Museum (Natural History), London.
BMS	— Basel Museum, Basel, Switzerland.
BPBM	— B. P. Bishop Museum, Honolulu, Hawaii.
CM	— Chicago Natural History Museum, Chicago, Illinois.
CMP	— Carnegie Museum, Pittsburgh, Pennsylvania.
DM	— Dominion Museum, Wellington, New Zealand.
GM	— Museo Civico di Storia Naturale di Genoa, Italy.
MCZ	— Museum of Comparative Zoology, Cambridge, Massachusetts.
MM	— Manchester Museum, Manchester, England.
NMV	— National Museum of Victoria, Melbourne, Australia.
SMF	— Senckenberg Museum, Frankfurt-am-Main, Germany.
UM	— Museum of Zoology, University of Michigan, Ann Arbor.
UMK	— Universitetets Museum, Kobenhavn, Denmark.
USNM	— United States National Museum, Washington, D.C.
ZM	— Zoologisch Museum, Amsterdam, The Netherlands.

* Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts

† Jour. Malac. Soc. Australia, 1963, no. 6, pp. 3-33; ibid., 1964, no. 8, pp. 36-71.

Genus *RHYNCHOTROCHUS* Möllendorff.

Rhynchotrochus Möllendorff, 1895, *Proc. Malac. Soc. Lond.*, 1:237 (type species, *Papuina tayloriana* Adams and Reeve, original designation).

Kathadena Iredale, 1941, *Aust. Zool.* 10:82 (type species, *Helix gurgustii* Cox, original designation).

Violenga Iredale, 1941, *Aust. Zool.*, 10:81 (type species, *Helix rollsiana* Smith, original designation).

Henga Iredale, 1941, *Aust. Zool.*, 10:81 (type species, *Geotrochus trobriandensis* Hedley, original designation).

Shell depressed, trochoid and usually keeled. Aperture depressed downward with the outer lip having a papuinoid notch and the subperipheral area drawn out into a beak or rostrum. Shells uniformly coloured, spirally banded or mottled.

The genus *Rhynchotrochus* is the most complicated among the elements in the Papuininae. It probably occupies most, if not all, of mainland New Guinea and many of the closely associated islands. Somewhat divergent groups in the Bismarcks, Louisiades, D'Entrecasteaux, and Trobriand Islands and Queensland are well differentiated and not at all difficult to separate as to species. Some species in New Guinea appear to merge into one another in colour pattern, shape and size.

Our present understanding of the species and forms composing this genus are certainly no more than tentative and will be subject to considerable modification when more material is at hand for study. The most serious handicaps at present are the lack of localized specimens, alcoholic material, and the complete inadequacy of many of the original descriptions.

ANATOMICAL NOTES

The jaws of the species dissected show a morphological series from those which are smooth or have faint to rather pronounced transverse lines in the mid section to those which are strongly ribbed. They do not vary, however, in shape or extent of ribbing within the species so far as could be determined from the limited material available for study.

The radulae also do not vary within the species and the greatest differences between the species are exhibited in the marginal teeth. The teeth are arranged in straight rows; the number per row ranging from 81 to 133.

The reproductive system is remarkably similar in the species for which the soft parts were available. In most specimens dissected the ovotestis was not sufficiently well preserved to allow detailed work. It appeared to be similar in all species and not distinctly lobed. The spermatheca has a long stalk with a slight to pronounced swelling at the base. In its normal position it is closely bound to and somewhat entwined with the prostate and uterus, the head reaching about one-half to two-thirds the distance to the albumin gland. The penial apparatus has a long epiphallus and small, stout flagellum. The basal half of the penial sheath is slightly to moderately muscular, the distal half thin and non-muscular. The penis papilla is extremely contractile and may appear very different in shape, depending upon the extent of contraction. The vas deferens opens into the epiphallus at the base of the flagellum, usually to the side and just subterminally. Throughout its length the vas deferens lies close against the oviduct, the vagina and penis on the back or ventral side. It is relatively short since the long epiphallus bends back upon the penis, reaching nearly to the atrium.

The entire penial complex varies greatly with the age of the specimens

and the conditions under which they were preserved. In addition, the various parts may contract independently and to varying extents, producing marked difference in appearance. Some of these variations are illustrated for *R. taylorianus*, the species for which we had the largest series for study. It would appear on the basis of this material that *taylorianus* and *kubaryi* are closely related, and it is possible that where their ranges overlap they may interbreed.

In the semi-diagrammatic illustrations the various organs have been separated and oriented in the same general way for all specimens in order that comparisons may be easily made.

To date the anatomy is known for only four of the twenty species included in *Rhynchotrochus* and, with the exception of *R. taylorianus*, only one or two preserved specimens were available. Consequently normal variation in the soft parts could not be ascertained. It is hoped that additional material will become available and that when the systematic studies of the subfamily Papuininae have been completed a comparative survey of the various groups can be made.

Rhynchotrochus (*Rhynchotrochus*) *taylorianus* (Adams and Reeve).

Plate 15, fig. 1-2; 5-15. Plate 16, fig. 4-6; 16. Plate 20, fig. 1-7.

Text figs. 1-3.

Helix tayloriana Adams and Reeve, 1850, *Zoology of the Voyage of H.M.S. Samarang*, 2, Mollusca, p. 59, pl. 15, fig. 2a-b (locality unknown [the area about Port Moresby, Papua]). [Holotype, BMNH no. 74.12.11.214.]

Helix rhynchonella Tapparone-Canefri, 1886, *Ann. Mus. Stor. Nat. Genova*, 24:134 (Ansus, Island of Giobi [Japen Id., West New Guinea]). [Holotype, GM.]

Papuina planogyra Möllendorff, 1895, *Proc. Malac. Soc. Lond.*, 1:236, pl. 15, fig. 5 (Constantinhafen, German New Guinea). [Lectotype, SMF no. 8641.]

Papuina tayloriana, form *genulabris* Möllendorff, 1895, *Proc. Malac. Soc. Lond.*, 1:236 (Constantinhafen, German New Guinea). [Lectotype, SMF no. 8656.]

Rhynchotrochus monticola Iredale, 1941, *Austr. Zool.*, 10:77, pl. 4, fig. 2 (Mount Astrolabe, Papua). [Holotype, AM no. C.62656 and topotypes BMNH no. 80.3.30.4; MCZ no. 191972.]

Rhynchotrochus sinucola Iredale, 1941, *Aust. Zool.*, 10:77, pl. 4, fig. 4 (Cloudy Bay, south coast of Papua). [Holotype, AM no. C.19510.]

Rhynchotrochus praefectus Iredale, 1941, *Aust. Zool.*, 10:77, pl. 4, fig. 3 (Collingwood Bay, N.E. Papua). [Holotype, AM no. C.18887.]

Papuina tayloriana major 'Strubell' Schepman, 1918, *Zool. Meded. Rijksmus. Natuur. Hist., Leiden*, 4:8 (near S. coast of Humboldt Bay and Hollandia, New Guinea).

Description: Shell subdepressed, trochiform, imperforate, nearly smooth, glossy and reaching 33.5 mm. (1⅜ inches) in greatest diameter. Ground colour variable, generally yellowish with pinkish purple on the base and on the upper whorls. Additional colour of a marbled purple or brown in the form of flecks in spiral bands of colour both above and below the periphery. Outer lip a dark purplish black. Interior of shell white to dark purple. Many specimens do not have the purple-brown colour pattern, but have pinkish or white early whorls and a yellow body whorl. Whorls 5, very acutely keeled and somewhat flattened. Spire

subdepressed, slightly obtuse and produced at an angle of about 92°. Aperture subelliptical and rostrate, descending very slightly with a well defined, shallow notch and cast at an angle of about 40° from the base. Outer lip reflected, rostrate and purplish black in colour; parietal wall thinly glazed. Columella very short and slightly flattened. Suture slightly indented. Sculpture consisting of numerous, irregular, incised lines, oblique above and spiral below the whorl periphery. Protoconch smooth, about 1½ whorls and coloured either light or dark.

Height	Width	
23 mm.	33 mm.	Milne Bay, Eastern Division, Papua.
18 mm.	32.5 mm.	Orokolo, Gulf Division, Papua.
15 mm.	32.5 mm.	Hollandia, West New Guinea.
15 mm.	31 mm.	,, ,, ,, ,,
14 mm.	25 mm.	Ali Id., 18 mi. E. of Aitape, Northeast New Guinea.
14.5 mm.	27 mm.	Jamna Id., West New Guinea.

Remarks: This is an extremely variable species, both in size and colour. A given colony is usually of a rather uniform size, but the colour pattern may vary from nearly unicolourous specimens to those which are strongly banded and flecked.

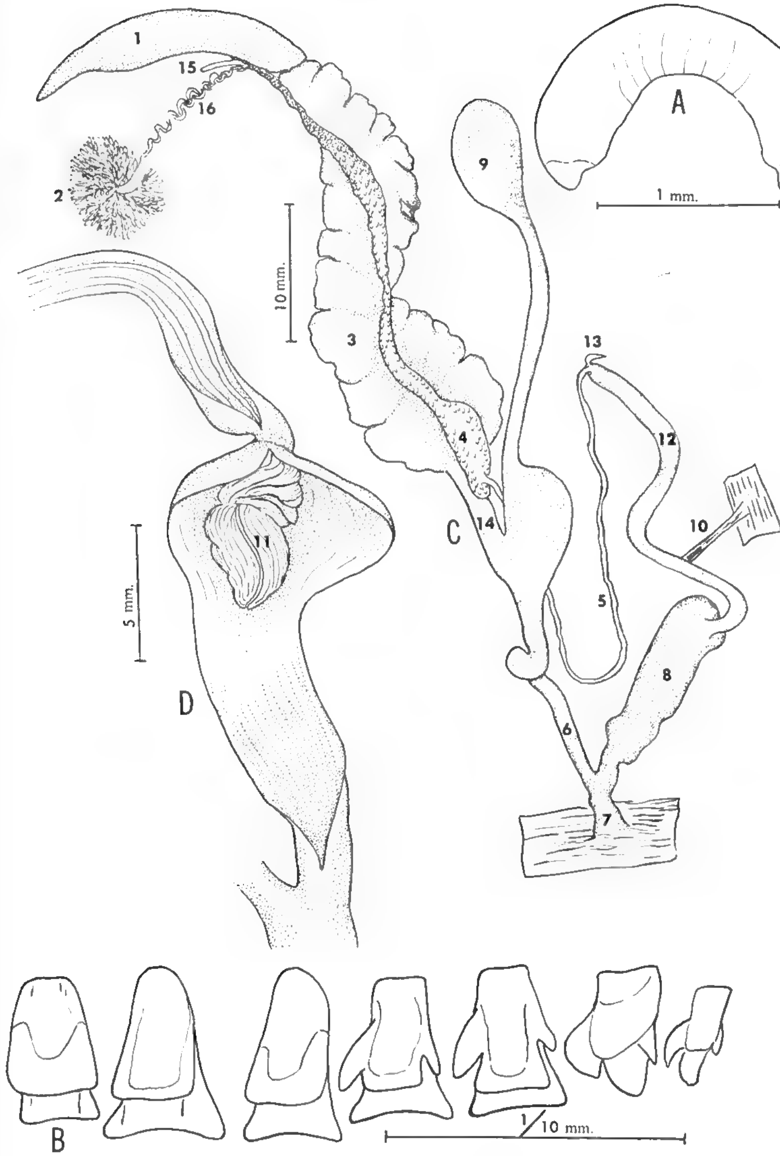
Isolated specimens may appear quite different, but when a large series is studied it is impossible to separate groups even to subspecies.

This species is closely related to *R. kubaryi* (v. Möllendorff) which it resembles in many of its colour patterns; however, *kubaryi* is rounded rather than strongly keeled at the periphery.

Head and dorsal part of the body usually yellowish, the back of the neck with two gray streaks running posteriorly from the base of the black tentacles, the tips of which are yellow. Foot gray; mantle light tan, the edge of the mantle dark brown to black. Sole of foot in preserved specimens smooth to finely knobby with as many as twenty fine knobs in a straight row across the foot. This appears to be a variable character because in a single lot all with similar appearing shells, some specimens may have a smooth foot, while in others only the anterior portion is knobby, and in a few the entire foot, except the posterior tip, is knobby. Jaws smooth. Text figs. 1-3 illustrate the variation which can be found in the reproductive system of this species, particularly in the penial complex.

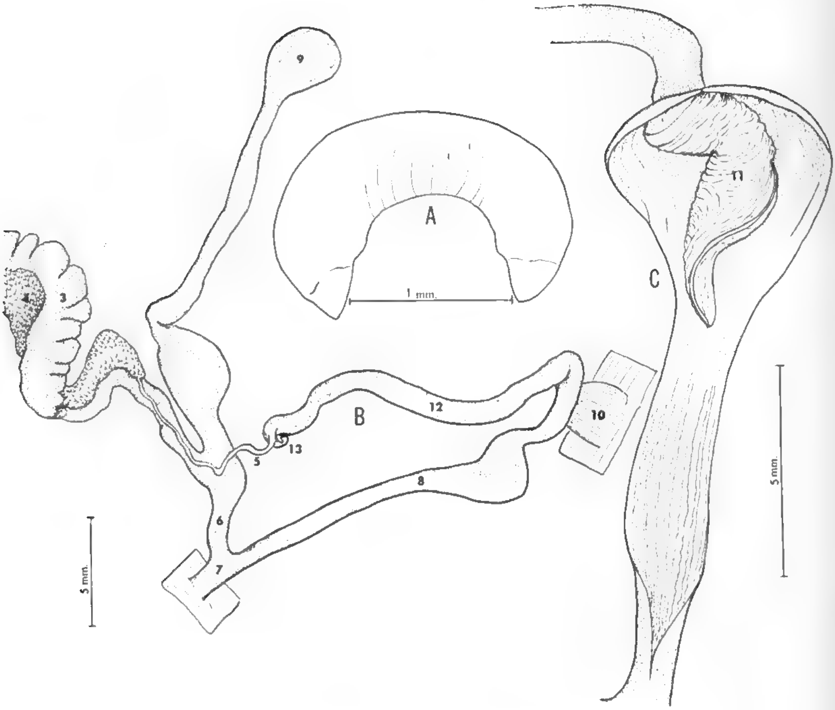
The penial retractor muscle of the specimen illustrated in text fig. 1 was relaxed, the penis papilla small and contracted, and the lower muscular portion of the penial sheath was relaxed so that the pilasters were scarcely evident. The penial retractor muscle of the specimen shown in text fig. 2 was contracted, the penis papilla moderately extended, and the pilasters of the basal portion of the sheath, as a result of the contraction, were quite prominent. The penis papilla of the specimen illustrated in text fig. 3 was somewhat extended and pushed the pilasters into transverse folds, giving the inner surface of the sheath a strikingly different appearance.

Specimens examined: West New Guinea: Sowek, Soepiori Id., Schouten Is. (ANSP); near Napaan, southern Geelvink Bay; Village of Mantemboe, near Seroei, Japen Id. (both AM); Samberbaba, Japen Id. (ANSP); upper Namoena River (tributary of Mamberamo), near Pionierbivak; Kama River (tributary of Koekoendoeri); upper Koekoendoeri



Text figure 1.

Rhynchotrochus taylorianus (Adams and Reeve). Sangara Plantation near foot of Mount Lamington, Papua. A. Jaw with indistinct tranverse lines. B. Radular teeth. C. Reproductive system. D. Dissected penis. Labelling for the reproductive system:—1, albumen gland. 2, ovotestis. 3, uterus. 4, prostate gland. 5, vas deferens. 6, vagina. 7, atrium. 8, penis. 9, spermatheca. 10, penial retractor. 11, penis papilla. 12, epiphallus. 13, flagellum. 14, oviduct. 15, talon. 16, seminal vesicle. 17, ovotestis duct.

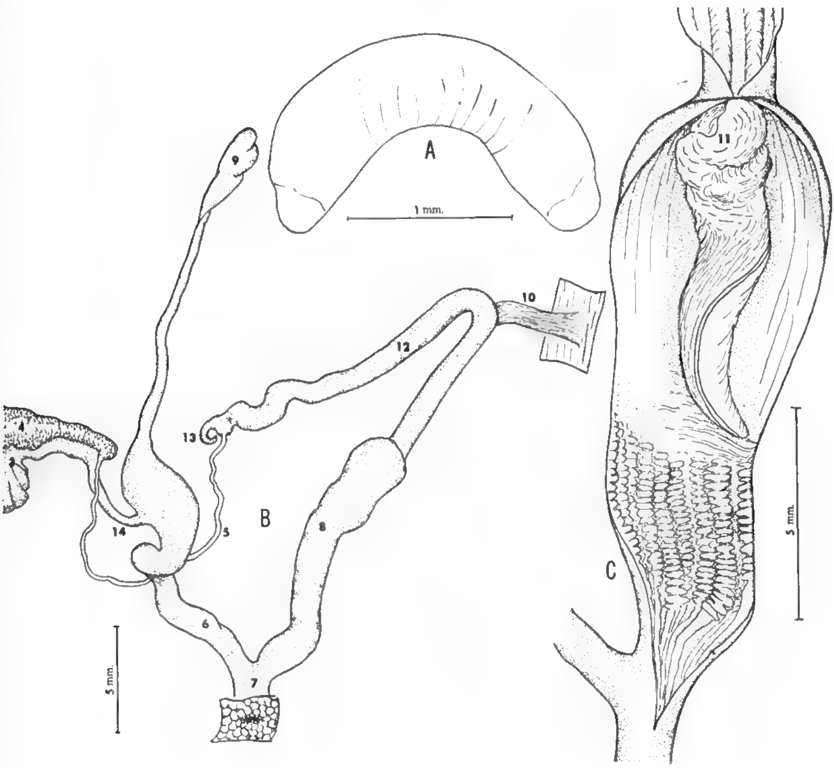


Text figure 2.

Rhynchotrochus taylorianus (Adams and Reeve). Gwemgwumgwak Village, near Wantoat, Northeast New Guinea. A. Jaw. B. Basal portion of reproductive system. C. Dissected penis. (See text figure 1 for labelling of reproductive system.)

(tributary of Mamberamo), inland from Sarmi; near Sarmi (all AM); Insoemaar Island, Wakde Ids. (MCZ); Jamna Island (MCZ; USNM; UM; BMNH); Tanah Merah; Oinaké; Tami (all ZM); Hollandia (CM); Moso River, Humboldt Bay (ZM); Hills east of Hollandia at 1000 to 1500 ft. (AM); Sekanto River (ZM). NORTHEAST NEW GUINEA: Aitape (MCZ); Ali Island, about 18 miles E. of Aitape (CM); Government Station, Aiome; Banup Plantation, 30 miles N. of Madang; Mikaref; Abegani; between Pir and Gorak; between Akokom and Abegani; near Dinam; near Mikera; between Akokomoud and Giri; between Aringin and Pir, all Madang District (All AI); near Sek; Gwemgwumgwak, near Wantoat; Surawaged Mts., about 60 miles N.W. of Lae at 3500 feet; Botanic Gardens, Lae (all AM). PAPUA: Between the Kumusi and Mambare Rivers, Ioma subdistrict; Higatura, Mt. Lamington, Sangara District (both NMV); Sambo Village, Mt. Lamington (AM), Mamoo Estate, Popendetta (AM); Saputa, Popendetta, about 12 miles S.W. of Buna; 20 miles S.W. of Buna (both NMV), all Northern Division; Cap Sud-est, 10 miles S.E. of Buna, Northeastern Division (Stanford Univ.); Eroro, near Oro Bay; near Eroro Mission, about 20 miles S.S.E. of Buna (both AM); Iototo Creek, near Mt. Britannia, Cape Nelson (MCZ); Collingwood Bay (AM), all Northeastern Division; Milne Bay (Stanford Univ.; MCZ; UM;

USNM; BMNH); Cloudy Bay, both Eastern Division; Aipiana (AM); Mekeo People (AM), (8° 34′ S.; 146° 33′ W.); inland from Yule Island (M. Kleckham); Yule Id. (AM; NMV; MCZ; ANSP); Mt. Astrolabe (AM; MCZ), all Central Division; Iokea (MCZ); Cape Cupola; Kerema (NMV); Kerema (USNM); Vailala, near Orokolo (R. Jackson); Orokolo (AM; Stanford Univ.), all Gulf Division; Middletown, Kikori River, near Kikori, Delta Division (AM).



Text figure 3.

Rhynchotrochus taylorianus (Adams and Reeve). Mantemboe Village, near Seroei, Japen Id., West New Guinea. A. Jaw. B. Basal portion of reproductive system. C. Dissected penis. (See text figure 1 for labelling of reproductive system.)

Rhynchotrochus (*Rhynchotrochus*) *kubaryi* (Möllendorff).

Plate 19, fig. 1-3; Plate 21, fig. 5-7; Text fig. 4.

Papuina kubaryi Möllendorff, 1895, *Proc. Malac. Soc. Lond.*, 1:236, pl. 15, fig. 4 (Constantinhafen [Astrolabe Bay], German New Guinea [Northeast New Guinea]). [Lectotype, SMF no. 8635a, Zilch, 1960, p. 198, pl. 16, fig. 6.]

Papuina kubaryi albina Möllendorff, 1895, *Proc. Malac. Soc. Lond.*, 1:236

(Constantinhafen [Astrolabe Bay], German New Guinea). [Lectotype, SMF, no. 8637, Zilch, 1960, p. 198, pl. 16, fig. 7.]

Papuina kubaryi albida Ancey, 1895, *Proc. Linn. Soc. New South Wales,* (2), 10:377 (German (?) New Guinea).

Papuina kubaryi albolabiata Schepman, 1918, *Zool. Meded. Rijksmus. Natuur. Hist., Leiden,* 4:9 (mouth of the Sermorvai River, Dutch New Guinea). [Holotype, ZM.]

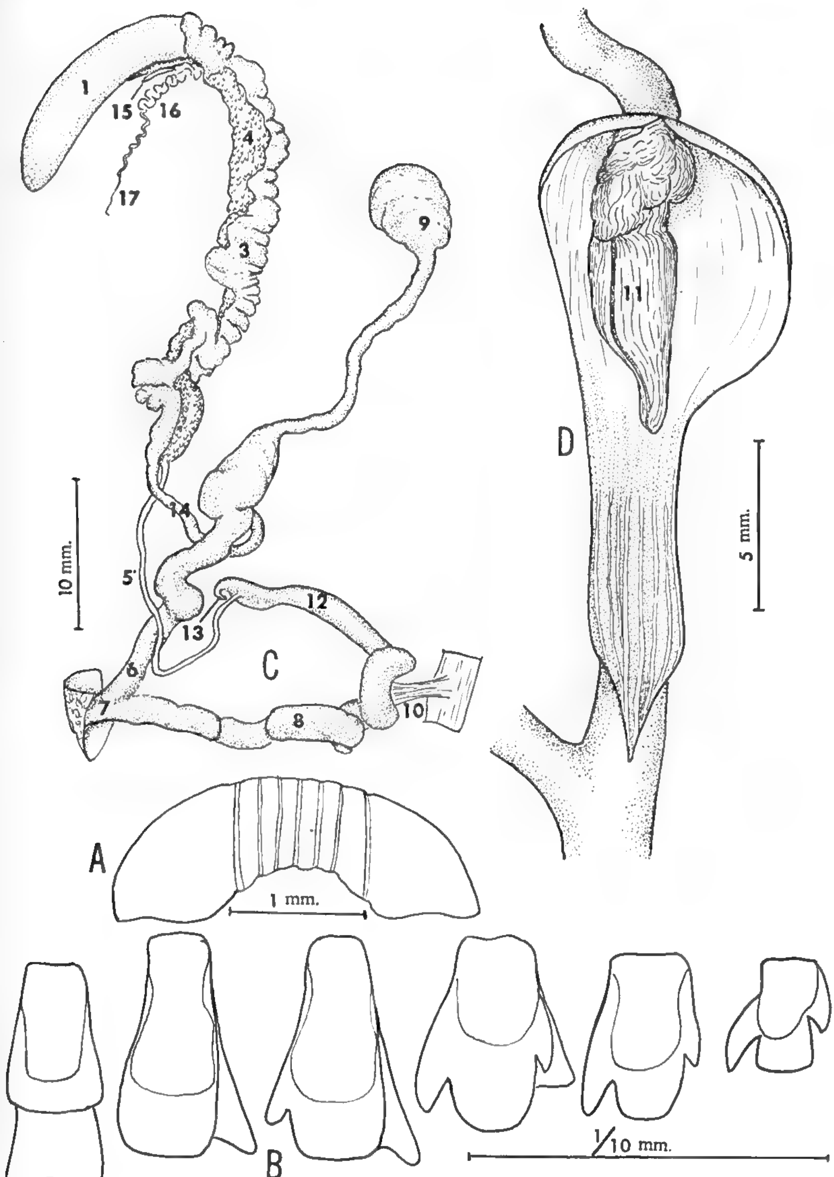
Description: Shell subglobose, imperforate, nearly smooth, glossy, and reaching 25 mm. in greatest diameter. Ground colour pale ivory to yellow with some purple in the parietal area. There are two rather broad bands of colour above and below the periphery of the whorl. They are mottled, are a dark purplish brown colour, and become stronger near the aperture. When viewed from within the aperture the dark coloured areas are translucent, the light areas opaque. The upper band is generally wider and may break into two or three secondary bands. The lip is generally a dark purplish brown. Some specimens lack the supraperipheral band, having only a narrow dark band below the periphery and a dark margin to the lip. The remainder of the shell is a pale ivory and becomes an intense yellow-orange near the lip. Other specimens lack all bands, having only the dark embryonic tip and the dark lip. Albinistic forms are common and have given rise to the several names that appear in the synonymy above. Spire subdepressed, obtuse and produced at an angle of about 100°. Aperture auricular in outline, descending slightly, with a well defined papuinoid notch and cast at an angle of about 25° from the base. Outer lip reflected and generally a dark chocolate-brown though occasional specimens have a white lip. Parietal area purplish. Suture slightly indented. Sculpture consisting of very fine oblique growth lines crossed by short and irregular interrupted threads. Protoconch not well differentiated.

Height	Width	
18 mm.	25 mm.	Constantinhafen, Astrolabe Bay, Northeast New Guinea.
15.5 mm.	23 mm.	Mamberamo River, West New Guinea.
15.5 mm.	24 mm.	Near Mosso River, West New Guinea.
20 mm.	31 mm.	Tawarin, near Hollandia, West New Guinea.

Remarks: All of the synonyms given above were based on albino or partially albino specimens. These cannot be separated from the typical form as they occur in the same colony. In addition, these albinistic forms show clear and opaque areas when seen with transmitted light, the translucent areas are those that are pigmented in the coloured forms.

Specimens of this species from the vicinity of Hollandia, West New Guinea, are somewhat larger in size but the colour pattern is identical.

Undersurface of foot yellowish; the upper surface as well as the head, tentacles and mantle gray to brownish black with yellow reticulations. Anterior portion of the sole of the foot distinctly and coarsely knobby in preserved specimens; there being about 5 knobs in each slightly diagonal row across the foot. Posterior portion of foot smooth. Five specimens were dissected and the reproductive systems of these showed variations similar to that illustrated for *R. taylorianus*. The jaw of *kubaryi*, while not grooved as in *macgillivrayi*, is more distinctly



Text figure 4.

Rhynchotrochus kubaryi (Möllendorff). New Pionierbivak, West New Guinea. A. Jaw with distinct transverse lines but lacking raised ribs. B. Radular teeth. C. Reproductive system (lacking ovotestis). D. Dissected penis. (See text figure 1 for labelling of reproductive system.)

marked than *taylorianus.* The radula is nearly identical to that of *taylorianus.*

Specimens examined: WEST NEW GUINEA: Pionierbivak, Mamberamo River; near Mosso River; Koeama River, E. of New Pionierbivak (all AM; MCZ; ZM); Upper Koekoendoeri River, inland from Sarmi (AM); Upper Namoena River, tributary of the Mamberamo River, near Pionierbivak (AM). NORTHEAST NEW GUINEA: Subra, at 2000 feet, near Saidor; Saidor (both AM); Constantinhafen, Astrolabe Bay (MCZ; MM; UM; USNM).

Rhynchotrochus (*Rhynchotrochus*) *strabo* (Brazier).

Plate 15, fig. 16-18. Plate 16, fig. 1-3.

Plate 19, fig. 6-11. Plate 21, fig. 1-2.

Helix (*Geotrochus*) *strabo* Brazier, 1876, *Proc. Linn. Soc. New South Wales,* 1:106 (Katau River [Binaturi River, near Daru, Western Division, Papua]). [Lectotype, here selected, AM no. C.62381; paratypes, Macleay Mus., Sydney, no. A57.]

Helix katauensis Tapparone-Canefri, 1883, *Ann. Mus. Stor. Nat. Genova,* 19:126, pl. 3, fig. 1-3; pl. 6, fig. 3 (Katau [Binaturi River, 10 miles W. of Daru, Western Division, Papua]). [Holotype, Genova Mus.]

Helix (*Papuina*) *roseolabiata* Smith, 1887, *Ann. Mag. Nat. Hist.,* (5), 19:421, pl. 15, fig. 2 (Ferguson Id., D'Entrecasteaux Group [Papua]), non *Papuina roseolabiata* Schepman, 1918.

Rhynchotrochus extraneus Iredale, 1941, *Aust. Zool.,* 10:98, pl. 4, fig. 6 (Kerema, Gulf of Papua). [Holotype, AM no. C.62657.]

Rhynchotrochus vallicola Iredale, 1941, *Aust. Zool.,* 10:78, pl. 4, fig. 5 (Purari River, Papua). [Holotype, AM no. C.30643.]

Description: Shell subdepressed, trochiform, imperforate, nearly smooth, glossy, and reaching 31 mm. (about 1¼ inches) in greatest diameter. Ground colour a creamy white with the peristome pink. There are three basic colour patterns: those shells which are almost entirely creamy white with a pink lip, others that are a creamy white and have a peripheral band of reddish brown, and the third group which has a white peripheral band with marbled reddish brown over most of the surface. In both the second and the third groups, the nuclear whorls may be white or blackish brown. In the first group they are always white. Whorls 4½, acutely keeled, somewhat flattened above and convex below the periphery. Spire subdepressed, slightly obtuse and produced at an angle of about 100°. Aperture subelliptical, rostrate, descending very slightly, with a very well defined though shallow notch, and cast at an angle of 32° from the base. Outer lip reflected, rostrate, and pinkish in colour. Parietal wall thinly glazed. Columella very short. Suture slightly indented. Sculpture consisting of numerous irregular oblique incised lines. Protoconch smooth.

Height	Width	
15.5 mm.	30.5 mm.	Maclatchie Point, Gulf Division, Papua.
18.5 mm.	29 mm.	Albert Mountains, ,, ,, ,,
14.5 mm.	28.5 mm.	Purari River, ,, ,, ,,
21 mm.	35 mm.	Ioma subdistrict, between the Mambare and Kumusi Rivers, Northern Division, Papua.

Remarks: This is another complex of colour forms, all of which have received names, but again similar to other species in this genus, there is considerable variation in colour pattern within the species.

So far this species is limited to Papua and extends from the Western Division east to the Gulf Division.

The locality, Ferguson Island, D'Entrecasteaux Group, given by E. A. Smith, is certainly in error.

.. *Specimens examined*: PAPUA: Katau or Binaturi River, near Daru (ANSP); head of Oriomo River and head of Fly River (both Mrs. M. Kleckham), all Western Division; Kerema District, Albert Mts. (AM); Maclatchie Point (ANSP; BMNH); Purari River (AM), all Gulf Division; Popendetta, near Buna; Divinikoari, about 30 miles S.W. of Buna; Ioma subdistrict, between the Mambare and Kumusi Rivers (all NMV), all Northern Division.

Rhynchotrochus strabo dampierensis (Fulton).

Plate 16, fig. 17. Plate 21, fig. 3.

Papuina tayloriana dampierensis Fulton, 1920, *Proc. Malac. Soc. Lond.*, 14:2 (Dampier Id. [Karkar Id.], New Guinea). [Holotype, BMNH no. 1922.2.24.35; syntype, ANSP no. 127765.]

Description: Shell subdepressed, trochiform, keeled, imperforate, nearly smooth, glossy and reaching 24 mm. in greatest diameter. Ground colour a light yellowish brown, becoming a little more intense near the aperture. Outer lip pink. Early 2½ whorls having the suture margined above with a narrow brown band. Aperture subquadrate. Outer lip with a shallow papuinoid notch and a very short rostrum. Parietal wall thinly glazed. Spire depressed and produced at an angle of 95°. Sculpture consisting of wrinkles which are oblique above and spiral below the whorl periphery. Protoconch about one whorl, smooth, and coloured blackish purple.

Height	Width	
14 mm.	24 mm.	Holotype.
13.5 mm.	23.5 mm.	Paratype.

Remarks: This subspecies differs from *R. strabo* by being smaller, having a less developed rostrum, and having a subquadrate aperture.

Specimens examined: NORTHEAST NEW GUINEA: Dampier Id. [Karkar Id.] (ANSP).

Rhynchotrochus (*Rhynchotrochus*) *yulensis* (Brazier).

Plate 18, fig. 14-16.

Helix (*Geotrochus*) *yulensis* Brazier, 1876, *Proc. Linn. Soc. New South* Wales, (1), 1:105 (Yule Island, New Guinea); Cox, 1888, *Proc. Linn. Soc. New South Wales,* (2), 2:1063, pl. 21, fig. 5-6. [Lectotype, here selected, AM no. C.62382; and paratypes, MCZ no. 191398; ANSP no. 31551.]

Description: Shell subdepressed, trochiform, keeled, imperforate, nearly smooth, glossy and reaching 21.5 mm. in greatest diameter. Ground

colour ivory to pale yellow. Spiral colouration consisting of several narrow yellow to light brown bands on the base of the whorl. The upper half of the whorl is irregularly marbled with brown to purplish brown or yellow. Lip a light brown to rather dark reddish brown. Whorls 4 to 4½, moderately to acutely keeled; the body whorl flattened above the periphery and convex below. Spire subdepressed and produced at an angle of about 95°. Aperture subelliptical, moderately rostrate and usually slightly descending. Outer lip slightly reflected below and cast at an angle of about 35° from the base. Parietal wall with a very thin glaze. Columella very short and slightly flattened. Suture slightly indented, Sculpture consisting of numerous fine, irregular wrinkles, which are oblique above the whorl periphery and spiral below. Protoconch 1½ whorls, smooth, brown or colourless.

Height	Width	
18 mm.	24 mm.	Agats, West New Guinea.
14.5 mm.	22.5 mm.	Yule Id., Papua.
13 mm.	19.5 mm.	,, ,,
12.5 mm.	21 mm.	,, ,,

Remarks: This species is closely related to *R. taylorianus* (Adams and Reeve). It differs, however, in being much smaller, having a convex rather than flattened base to the body whorl, and having the outer lip less rostrate. The specimens from Agats, West New Guinea, appear to be this species. They differ only in a slight degree from specimens from Yule Id. by being a little larger and having the spiral bands solid on the last half of the body whorl.

Specimens examined: West New Guinea: Agats (5° 30′ S.; 138° 20′ E.) (MCZ). Papua: Yule Island (AM; NMV; MCZ; ANSP).

Rhynchotrochus (*Rhynchotrochus*) *jucundus* (Fulton).

Plate 15, fig. 3-4. Plate 19, fig. 12-14.

Papuina jucunda Fulton, 1902, *Ann. Mag. Nat. Hist.*, (7), 9:317 (German New Guinea). [Holotype, BMNH, 1902.5.28.39.]

Papuina caputserpentis Kobelt, 1914, *Nachrbl. Dtsch. Malakozool. Ges.*, 46:6; ibid. 1917, 49:6, pl. 1, fig. 5 (Agololo [Huon Peninsula] New Guinea).

Description: Shell subdepressed, trochiform, imperforate, nearly smooth, glossy and reaching 20 mm. (¾ inch) in greatest diameter. Ground colour a light straw-yellow with irregular, axial patches of a lighter yellow. Whorls 4½, sharply keeled, and slightly concave above the whorl periphery. Suture moderately indented. Spire subdepressed and produced at an angle of 85°. Aperture auricular in shape. Parietal wall thinly glazed. Outer lip slightly reflected with a well defined notch and coloured a dark brown. The aperture is cast at an angle of 55° from the base. Columella short. Sculpture consisting of irregular wrinkles, oblique above and in spiral arrangement below the whorl periphery. Protoconch of 1½ whorls and smooth.

Height	Width	
13 mm.	20 mm.	Northeast New Guinea.
14 mm.	23 mm.	Holotype of *jucundus* Fulton.
10 mm.*	23 mm.	Holotype of *caputserpentis* Kobelt.

* Error. According to his illustration, this measurement should be 14 mm.

Remarks: In relationship this species is fairly close to *R. taylorianus*, differing by being smaller than most specimens of this latter species, by having a smaller rostrum on the outer lip and by having irregular, axially arranged light yellow spots, a colour pattern different from that in *taylorianus*.

Specimens examined: NORTHEAST NEW GUINEA: (MCZ; BNMH).

Rhynchotrochus (*Rhynchotrochus*) *rhynchotus* (Boettger).

Plate 17, fig. 1-3. Plate 19, fig. 4-5.

Papuina rhynchota Boettger, 1918, *Abh. Senckenb. Naturf. Ges.*, 36:292, pl. 23, fig. 16a-c (Bismarck Archipelago). [Lectotype, SMF no. 5937.]
Papuina tayloriana septentrionalis I. & B. Rensch, 1929, *Zool. Anz.*, 80:79 (Weiten Bucht, Neu-Pommern [Wide Bay, New Britain], Bismarck Archipelago). [Holotype, BM; paratype, MCZ no. 83880.]

Description: Shell subdepressed, light in structure, but strong, reaching 22 mm. in greatest diameter, imperforate, shining and finely sculptured. Whorls 4, and acutely keeled. Ground colour ivory with a variable number of relatively narrow, chocolate-brown spiral bands of varying widths, both above and below the whorl periphery. Protoconch and lip also brown. Spire depressed, obtuse and produced at an angle of about 105°. Aperture subquadrate and slightly descending. Parietal lip consisting of a very thin glaze; palatal lip reflected below, and with a rather small papuinoid notch. Lip produced at an angle of about 45° from the base. Columella acutely arched, and with a small white area on the inner edge of the lip. Suture moderately well defined and not indented. Sculpture consisting of fine diagonal and irregular grooves.

Height	Width	
14 mm.	22.5 mm.	Wide Bay, Kalei, New Britain.
13 mm.	24 mm.	,, ,, ,, ,, ,,

Remarks: The name *rhynchotus* apparently was overlooked by I. and B. Rensch. Dr. Eugen Wolf, who had originally collected the specimens, gave only "Bismarck-Archipel" as the locality. On the basis of the studies of I. and B. Rensch we can limit the type locality to New Britain.

In relationship it appears close to *R. taylorianus* (Adams and Reeve) differing, however, by having a less developed rostrum and only a shallow papuinoid notch.

Specimens examined: NEW BRITIAN: Wide Bay, Karlei Terr. (MCZ).

Rhynchotrochus (*Rhynchotrochus*) *wiegmanni* (v. Martens).

Plate 17, fig. 4-12. Plate 20, fig. 8-11. Text fig. 5.

Helix (*Geotrochus*) *wiegmanni* v. Martens, 1894, *Conchologische Mitt-heilungen*, 3:10 (Solomon Islands and Tuom [Island, Siassi Islands, Bismarck Archipelago]); v. Martens, 1897, *Arch. Naturgesch.*, 63:41, pl. 8, fig. 1-4. [Holotype, BM.]

Papuina tuomensis Ancey, 1895, *Proc. Linn. Soc. New South Wales*, (2), 10:375, pl. 26, fig. 3 (German New Guinea [Tuom Id., Siassi Ids., Bismarck Archipelago]).

Papuina tuomensis, var. *heterochroa* Ancey, 1895, *Proc. Linn. Soc. New South Wales*, (2), 10:375, pl. 26, fig. 4 (German New Guinea [Tuom Id.,

Siassi Ids., Bismarck Archipelago]).

Papuina tuomensis, var. *violaceo-flava* Ancey, 1895, *Proc. Linn. Soc. New South Wales*, (2), 10:376 (Tuom Id. [Siassi Ids., Bismarck Archipelago]).

Papuina wiegmanni disjuncta Rensch, 1934, *Arch. Naturgesch.* (N.S.), 3:473, text fig. 13 (Pomeo, Jacquinot Bay, New Britain, Bismarck Archipelago). [Holotype, BM; paratypes, BMS no. 3921a; SMF no. 9594/3.]

Papuina wiegmanni conjuncta Rensch, 1934, *Arch. Naturgesch.* (N.S.), 3:473, text fig. 13 (Talassea and Ulamona, North coast of New Britain, Bismarck Archipelago). [Holotype, BM; paratypes, MCZ no. 225206; SMF no. 9593/3.]

Papuina wiegmanni parvula Rensch, 1940, *Zool. Anz.*, 131:35 (Unea, French Islands [Vitu Islands], Bismarck Archipelago). [Holotype, BM; paratype, MCZ no. 248799.]

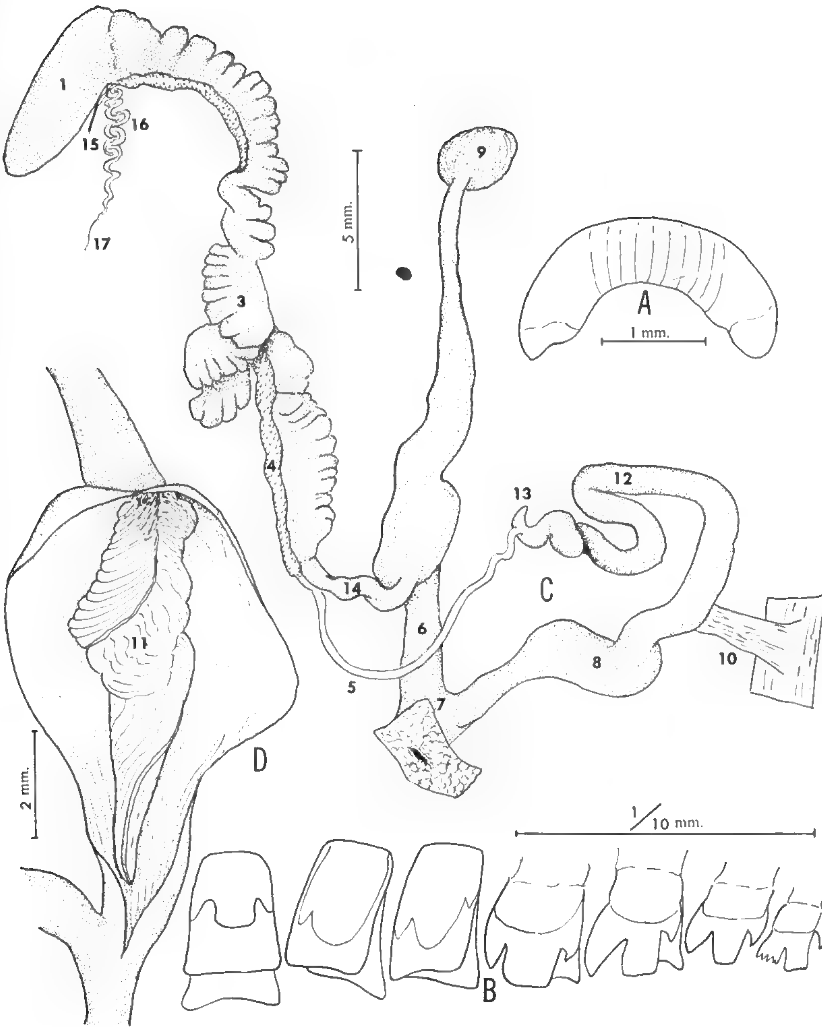
Description: Shell subdepressed to subglobose, imperforate, smooth, glossy and reaching 26 mm. in greatest diameter. Whorls 4½, and strongly convex. Ground colour white to ivory-white with the early whorls pink, white, or purplish. Usually banded with chocolate-brown, one band above and one below the periphery. These bands are often restricted to the body whorl and occasionally are entirely lacking. They can be very irregular both in width and in the intensification of colour. In a few specimens the bands merge into the brown of the lip, while in others they are separated from the lip by a narrow area of the ground colour. Occasionally there are two secondary bands, one at the suture and a thread-like band just above the supraperipheral band. Occasional specimens are completely white but in transmitted light the banded areas are translucent white and the remainder of the shell is an opaque white. Spire subdepressed, obtuse, and produced at an angle of about 105°. Aperture auricular in outline, descending slightly, produced at an angle of about 30° from the base and with a well defined papuinoid notch. Outer lip a dark chocolate-brown and reflected. Inner lip consisting of a thin glaze of brown on the parietal area. Columella short, broad, and merging into the base of the outer lip. Suture slightly indented. Sculpture consisting of very fine, oblique, growth lines; a few specimens possessing irregular and fine interrupted spiral threads. Protoconch not differentiated.

Height	Width	
18 mm.	25.5 mm.	Tuom Id., Siassi Ids.
12 mm.	20 mm.	,, ,,
15.5 mm.	25.5 mm.	Talassea, New Britain.
19 mm.	26 mm.	Paratypes of *disjuncta* Rensch.

Remarks: The whereabouts of Ancey's [1] types is unknown to us; his collection was sold to Garet, a Paris shell dealer, and subsequently dispersed. We know that many, if not all, of Ancey's types from Polynesia were purchased by C. M. Cooke for the Bishop Museum, Honolulu, Hawaii.

The taxonomy of this species has had a curious history. Many specimens were collected from the little island of Tuom, Siassi Islands, New Britain. These were originally sent to O. Staudinger, a Berlin insect dealer, from whom von Martens obtained his specimens. He described the various colour forms under the single name *wiegmanni*. About the same time Boettger also had access to this material and he gave manuscript names to several colour variations. Sets of these specimens were sold to

[1] Nautilus *21*:59, 1907.



Text figure 5.

Rhynchotrochus wiegmanni (v. Martens). Cape Hoskins, New Britain Id., Bismarck Islands. A. Jaw with fine transverse lines. B. Radular teeth. C. Reproductive system. D. Dissected penis. (See text figure 1 for labelling of reproductive system.)

various collectors under these manuscript names. Such a series was obtained by C. F. Ancey who, realizing that these were manuscript names, published them in the *Proceedings of the Linnean Society of New South Wales,* 1895, (2), 10:374-381. Apparently Ancey had not seen von Martens' description which had appeared only the year before.

Foot (in the single preserved specimen available) light tan, becoming grayish posteriorly, sole of foot smooth; head and tentacles unicolourous and light tan; mantle light, the edge a medium gray. Reproductive system similar to that for *taylorianus.* Marginal teeth of radula differing from *taylorianus* and *kubaryi* in having the inner denticle serrated.

This is a variable species, both in size and colouration, a fact which is reflected in the synonymy given above. Our present series is too small for a complete understanding of these variations, but certainly some of them occur together in a single colony.

The locality "Solomon Islands" by E. von Martens is in error.

Specimens examined: VITU IDS.: Unea Id. (ANSP). NEW BRITAIN Pilelo Id., Cape Mercus (MCZ; CM); Talassea (MCZ; BM); Jacquinot Bay; Ulamona (both ANSP; BM); Valoka, Cape Hoskins (UMK; MCZ); Tuom Id., Siassi Ids. (BMNH; MCZ; MM; USNM); southern end of Umboi Id., Siassi Ids. (J. Poling). NORTHEAST NEW GUINEA: Finschhafen (B. & J. Grigg).

Rhynchotrochus albocarinatus (Smith).

Plate 16, fig. 20. Plate 18, fig. 4-6; 11-13.

Helix (*Papuina*) *albocarinata* Smith, 1887, *Ann. Mag. Nat. Hist.,* (5), 19:422 (South Cape, British New Guinea [Trobriand Islands]). [Holotype, BMNH no. 87.5.19.2; paratype, AM no. C.11592.]

Geotrochus trobriandensis Hedley, 1891, *Proc. Linn. Soc. New South* Wales, (2), 6:92, pl. 9, fig. 28 (Trobriand Islands). [Lectotype, Queensland Museum no. MO.2810; paratypes, BMNH no. 92.2.6.45-50, ANSP no. 63071, and MCZ no. 225343.]

Rhynchotrochus mysticus Iredale, 1941, *Aust. Zool.,* 10:78, pl. 4, fig. 7 (South Cape, British New Guinea [Trobriand Islands]). [Holotype, AM no. C.62658.]

Description: Shell subglobose, reaching 27 mm. in greatest diameter, imperforate, smooth and glossy. Whorls 4½, strongly convex, and usually keeled at the periphery. Ground colour ivory with the early whorls a light yellowish brown to pinkish brown. Colour pattern variable, consisting of a series of spiral bands, both above and below the periphery, which are translucent white on opaque white; or the colour of the translucent band may vary in intensity from a light to a rather dark brown. The bands may be narrow and more or less evenly spaced, or two or more bands may coalesce. Whorls 5, convex, and with a rounded keel at the periphery. Spire subdepressed and produced at an angle of about 95°. Aperture subquadrate, cast at an angle of 40° from the base and with the papuinoid notch slightly to moderately developed. Outer lip narrow, reflected and white to chocolate-brown in colour. Inner lip consisting of a very thin glaze on the parietal wall. Suture slightly indented. Sculpture consisting of microscopic wrinkles with the irregular grooves running in more or less an oblique direction. Protoconch of 1½ whorls and smooth.

Height	Width	
17 mm.	27 mm.	N.W. Fergusson Id., D'Entrecasteaux Ids.
16.5 mm.	24 mm.	Omarakana, central Kiriwina, Trobriand Ids.
16 mm.	24 mm.	Sinaketa, South Kiriwina, Trobriand Ids.
16 mm.	22.5 mm.	Kaileuna Id., Trobriand Ids.

Remarks: Iredale instituted the genus *Henga*, selecting as its type species *Geotrochus trobriandensis* Hedley and included in it the species *Papuina williamsi* Clench and Archer and *Henga deliciosa* Iredale. In our opinion these are certainly species in the genus *Rhynchotrochus*.

This species is most closely related to *R. williamsi* but differs in having a dark brown lip, numerous spiral bands of brown and a white protoconch. The lip of *R. williamsi* is pink, the spiral bands show only as translucent areas and the protoconch is usually a dark brown. In addition *williamsi* is usually somewhat larger than *albocarinatus* and the periphery of the body whorl is more acute.

The type locality, South Cape, British New Guinea, is in error. The type locality is here selected to be Kiriwina Island, Trobriand Islands. This species is restricted to the D'Entrecasteaux and Trobriand Islands just north of the eastern end of New Guinea.

Specimens examined: D'ENTRECASTEAUX ISLANDS: N.W. Fergusson Id. (MCZ; CMP); Seymour Bay, Fergusson Id. (MCZ); Goodenough Id. (MCZ; BMNH; MM). TROBRIAND ISLANDS: Kaileuna Id. (MCZ; CMP); Vakuta Id. (MCZ; UM); Sinaketa, South Kiriwina Id. (MCZ); Omarakana, central Kiriwina Id. (MCZ; UM; BPBM; CMP); near Losuia, Kiriwina Id. (MCZ; CMP).

Rhynchotrochus (*Rhynchotrochus*) *woodlarkianus* (Souverbie).

Plate 18, fig. 13. Plate 22, fig. 7-10.

Helix woodlarkiana Souverbie, 1863, *J. Conchyliol.*, 11:76; 172, pl. 5, fig. 2 (Woodlark Island). [Holotype, Bordeaux Museum, France.]

Henga deliciosa Iredale, 1941, *Aust. Zool.*, 10:81, pl. 4, fig. 15 (Laughlan Island, Woodlark Islands). [Holotype, AM no. C.62666.]

Description: Shell subglobose, reaching 20 mm. in greatest diameter, imperforate, smooth and glossy. Colour and pattern variable. Shell basically translucent white with spiral bands and zig-zag patterns in opaque white. The translucent areas of the shell may be a light to dark reddish brown. Spire subdepressed and produced at an angle of about 105°. Aperture subquadrate and cast at an angle of 50° from the base. Papuinoid notch slightly to moderately developed. Outer lip narrow, reflected, and white to light brown. Inner lip consisting of a very thin glaze on the parietal wall. Suture slightly indented. Sculpture consisting of minute wrinkles with irregular grooves running in a more or less oblique direction above the whorl periphery and in spiral arrangement below. Protoconch of 1½ whorls and smooth.

Height	Width	
13.5 mm.	20 mm.	Woodlark Id.
11 mm.	18 mm.	Holotype of *deliciosa* Iredale.
14 mm.	20 mm.	Woodlark Id.
11 mm.	15.4 mm.	,, ,,

Remarks: In relationship this species is close to *Rhynchotrochus albocarinatus* (Smith). It differs in being very much smaller and in its type of colour pattern. In general the spiral pattern is far more uniform and pronounced in *albocarinatus*. In addition, the lip of *albocarinatus*, except in the albino form, is a dark chocolate-brown and the lip is not as broadly reflected as in *woodlarkianus*. *Henga deliciosa* Iredale appears to be an albino form of *woodlarkianus*.

Specimens examined: WOODLARK ISLANDS: Woodlark Id. (MCZ; BMNH; CMP; ANSP; UM; USNM); Laughlan Id. (AM).

Rhynchotrochus (*Rhynchotrochus*) *williamsi* (Clench and Archer).

Plate 22, fig. 1-6.

Papuina williamsi Clench and Archer, 1936, *Nautilus*, 49:88, pl. 5, fig. 4 (Omarukana, Kiriwina Island, Trobriand Islands). [Holotype, MCZ no. 110396; paratypes, MCZ no. 111149.]

Papuina williamsi atalanta Clench, 1936, *Nautilus*, 50:54 (Omarukana, Kiriwina Island, Trobriand Islands). [Holotype, MCZ no. 111151; paratypes, MCZ no. 111152.]

Description: Shell globose, reaching 27 mm. in greatest diameter, imperforate, smooth and glossy. Ground colour ivory with a suffusion of yellowish to golden brown near the aperture. Specimens nearly uniform in colour with the colour more intense near the aperture or with numerous faint to pronounced spiral bands which are translucent when viewed through the aperture. Lip white to light pink. Whorls 5, convex and with a rounded keel at the periphery. Spire subdepressed and produced at an angle of about 95°. Aperture subquadrate, cast at an angle of 40° from the base and generally with the papuinoid notch moderately developed. Outer lip narrow and reflected. Inner lip consisting of a very thin glaze on the parietal wall. Suture slightly indented. Sculpture consisting only of microscopic wrinkles with the irregular grooves running in a more or less oblique direction above the whorl periphery and spirally below. Protoconch of 1½ whorls, smooth and coloured a blackish brown.

Height	Width	
21.5 mm.	25.7 mm.	Paratype.
20.5 mm.	27.5 mm.	,,
20.5 mm.	27 mm.	,,
20 mm.	25.5 mm.	,,
17.5 mm.	25.5 mm.	Holotype.
19.5 mm.	26 mm.	Paratype.
18 mm.	25.5 mm.	,,

Remarks: This species is very close to *R. albocarinatus* (Smith) differing mainly in its type of colouration. In *R. williamsi* the protoconch is blackish brown and the lip is pink or pinkish white, while in *albocarinatus*

the protoconch is white or glass-like and the lip a dark brown. Also the shell of *williamsi* is heavier and the lip more reflected. The colouration of *albocarinatus* is more uniform, not increasing greatly in intensity near the aperture as in *williamsi*.

This species is known only from Kiriwina Island in the Trobriand group.

Specimens examined: TROBRIAND ISLANDS: Omarakana, central Kiriwina Id. (MCZ; UM; AM).

Rhynchotrochus (*Rhynchotrochus*) *rollsianus* (Smith).

Plate 18, fig. 10.

Helix (*Papuina*) *rollsiana* Smith, 1887, *Ann. Mag. Nat. Hist.*, (5), 19:422, pl. 15, fig. 12 (South Cape, British New Guinea [Fergusson Island, d'Entrecasteaux Islands]). [Holotype, BMNH no. 83.3.23.3.]

Description: Shell subglobose, reaching 34 mm. in greatest diameter, imperforate, finely sculptured and glossy. Whorls 4½, convex, rounded at the periphery, with occasional specimens showing a faint keel near the aperture. Ground colour white, early whorls generally suffused with pink, the parietal area also with a pink tinge. Most specimens have spiral bands of brown both above and below a broad white band at the periphery. The back of the outer lip usually is a rather deep orange. Protoconch white or blackish brown. Rarely specimens are found which are nearly white, having only the pink suffusion at the parietal area and the orange colouration behind the lip. Spire subdepressed and produced at an angle of about 110°. Aperture subquadrate and cast at an angle of 30° from the base. The papuinoid notch moderately developed. Outer lip wide, reflected and white. Inner lip consisting of only a thin glaze on the parietal wall. Suture slightly indented. Sculpture consisting of microscopic wrinkles with the irregular grooves running in a more or less oblique direction. Protoconch 1½ whorls and smooth.

Height	Width	
20 mm.	34 mm.	Seymour Bay, Fergusson Id.
16 mm.	25.5 mm.	,, ,, ,,
20.5 mm.	33 mm.	Salamo, ,,
16.5 mm.	25.5 mm.	,, ,,
19.5 mm.	32 mm.	North West Fergusson Id.
17 mm.	25.5 mm.	,, ,, ,,

Remarks: This is a very distinctive species and apparently not closely related to any other species in *Rhynchotrochus*.

The original locality of South Cape, British New Guinea, is certainly in error.

Specimens examined: D'ENTRECASTEAUX ISLANDS: N.W. Fergusson Id. (MCZ; UM); Seymour Bay (MCZ; CMP); Salamo (MCZ; UM), both Fergusson Id.; Fergusson Id. (AM; BPBM; UM; USNM; ANSP; MCZ).

Rhynchotrochus (*Rhynchotrochus*) *rhombostomus* (Pfeiffer).

Helix rhombostoma Pfeiffer, 1845, *Proc. Zool. Soc. Lond.*, p. 72 (locality unknown); Reeve, 1854, *Conchologia Iconica*, 7, fig. 1456.

Helix (*Papuina*) *rhombostoma* Pfeiffer. Pilsbry, 1891, *Manual of Conchology*, (2), 7:60, pl. 16, fig. 14-15.

Description: "Imperforate, trochiform, rather thin, obliquely striatulate, subdecussated with very close concentric lines, rather shining, whitish-tawny, ornamented with a number of chestnut bands; spire short, conic; apex acute. Whorls 5, rather flat, the last acutely carinated, slightly convex beneath, little descending in front; peristome violaceous, upper margin expanded, impressed above, columellar margin straightened, dilated, flat, appressed."

Height	Width	
15 mm.	28 mm.	Holotype.

Remarks: This species is unknown to us and we give above Pilsbry's translation of Pfeiffer's original Latin description. Pilsbry relates it to *R. strabo* (Brazier) as being intermediate between that species and *R. louisiadensis* (Forbes). The type locality may be somewhere in eastern New Guinea.

Rhynchotrochus (*Rhynchotrochus*) *misima* (Iredale).

Plate 16, fig. 10-12; 19.

Helix (*Geotrochus*) *thomsoni* Smith, 1889, *Ann. Mag. Nat. Hist.*, (6), 4:202, pl. 13, fig. 12-13 (St. Aignan [Misima] Island, Louisiade Islands); non *Helix thomsoni* Pfeiffer, 1871. [Lectotype of *thomsoni* Smith, BMNH no. 89.6.25.60.]

Violenga misima Iredale, 1941, *Aust. Zool.*, 10:81, pl. 4, fig. 16 (new name for *Helix* (*Geotrochus*) *thomsoni* Smith; non *H. thomsoni* Pfeiffer).

Description: Shell reaching 28 mm. in greatest diameter, solid in structure, imperforate and sculptured. Whorls 4 and convex. Colour ivory-white to purple and mottled. The mottled areas are translucent when viewed with transmitted light, are generally disposed in a diagonal pattern above the whorl periphery and occasionally below. Behind the lip there may be a narrow band of brownish yellow. Spire reduced, obtuse and produced at an angle of about 120°. Aperture descending, subquadrate in shape, with a well defined papuinoid notch and cast at an angle of 60° from the base. Parietal lip thinly glazed. Palatal lip white and broadly reflected. Columella very short. Suture well defined. Sculpture consisting of a very fine lacing of grooves and ridges set diagonally above the whorl periphery and in spiral arrangement below. Protoconch of 1½ whorls, white and smooth.

Height	Width			
15 mm.	26 mm.	Misima	Island,	Louisiade Islands.
16.2 mm.	27 mm.	,,	,,	,,
17 mm.	28 mm.	,,	,,	,,

Remarks: This species is close in its relationship to *R. louisiadensis* (Forbes) which has a similar colour pattern. It differs by being brownish, having the lip pink and the aperture not descending. It is more distantly related to *R. williamsi* (Clench and Archer) from the Trobriand Islands and to *R. rollsianus* (Smith) of the d'Entrecasteaux Islands, differing from both in shape and colouration.

Specimens examined: LOUISIADE ISLANDS: Misima Id. [St. Aignan] (CM; USNM; MCZ; AM; UM; ANSP); Moturina Id. (AM; MCZ).

Rhynchotrochus (*Rhynchotrochus*) *louisiadensis* (Forbes).

Plate 16, fig. 18. Plate 19, fig. 15-16.

Helix louisiadensis Forbes, 1851, (in) *Narrative of the Voyage of H.M.S. Rattlesnake,* 2:376, pl. 2, fig. 8a-b (South-east Island [Tagula or Sudest], Louisiade Archipelago). [Holotype, BMNH no. 51.11.24.7.]

Helix millicentae Cox, 1871, *Proc. Zool. Soc. Lond.*, p. 323, pl. 34, fig. 2-2a (Louisiade Islands). [Lectotype, AM no. C. 62380; paratypes, ANSP and MCZ no. 191975.]

Violenga millicentae Cox. Iredale, 1941, *Aust. Zool.,* 10:81.

Description: Shell subglobose, imperforate, nearly smooth, glossy, and reaching 26 mm. (about 1 inch) in greatest diameter. Ground colour a pale ivory with numerous brownish bands both above and below the periphery. These bands may be fused in part or the banded area may be completely mottled. Lip white to light pink to a moderately dark purplish pink. Whorls 4½, convex and occasionally bluntly keeled but generally with the periphery rounded. Spire subdepressed, slightly obtuse and produced at an angle of about 95°. Aperture subcircular, descending very slightly, generally with a poorly defined notch and cast at an angle of 45° from the base. Outer lip reflected. Parietal wall thinly glazed. Columella short. Suture slightly indented. Sculpture consisting of numerous irregular, oblique incised lines. Protoconch smooth and varying in colour from whitish to dark brown.

Height	Width	
19 mm.	25 mm.	Tagula [Sudest] Island, Louisiade Ids.
19.1 mm.	24.6 mm.	„ „
16.5 mm.	22.5 mm.	Lectotype of *millicentae* Cox.

Remarks: *Helix millicentae* Cox is only a white lipped form of *louisiadensis* and in other respects it does not appear to differ from the typical form. Both white and pink lip forms may occur in the same colony.

This species is most closely related to *Rhynchotrochus misima* (Iredale) from Misima [St. Aignan] Island, Louisiade Islands. It differs, however, in being smaller, by having a far less pronounced papuinoid notch, and in being tinged with pink rather than with lavender as is the case with *misima.*

So far as now known, this species is restricted to Tagula Island in the Louisiade Islands.

Specimens examined: LOUISIADE ISLANDS: Tagula [Sudest] Id. (MCZ; AM; M. Kleckham).

Rhynchotrochus (*Rhynchotrochus*) *gurgustii* (Cox).

Plate 16, fig. 7-9.

Helix (*Geotrochus*) *gurgustii* Cox, 1879, *Proc. Linn. Soc. New South Wales,* 4:114, pl. 16, fig. 1 (Rossel Island, Louisiade Archipelago). [Holotype, AM no. C.62668.]

Kathadena gurgustii Cox. Iredale, 1941, *Aust. Zool.,* 10:82.

Description: Shell trochiform, imperforate, nearly smooth, glossy, and reaching 32 mm. (about 1¼ inches) in greatest diameter. Ground colour an ivory-white with a subperipheral spiral band of brown. This

same brownish colouration margins the reflected portion of the outer lip. The margin of the lip within the aperture is pink. Whorls 5½, sharply keeled to within ½ whorl from the aperture, where the keel becomes rounded as it approaches the aperture. Spire somewhat elevated and produced at an angle of about 75°. Aperture sub-elliptical, rostrate, descending slightly, having a broad, shallow papuinoid notch and cast at an angle of 30° from the base. Outer lip reflected. Parietal wall thinly glazed. Columella very short. Suture slightly indented. Sculpture consisting of fine, irregular, and somewhat oblique granulations. Protoconch 1½ whorls, smooth and glass-like.

Height	Width	
25.5 mm.	32 mm.	Rossel Island, Louisiade Archipelago.
23.5 mm.	30.5 mm.	„ „ „ „

Remarks: So far as known, this species is limited to Rossel Island. It appears to be a somewhat aberrant *Rhynchotrochus* but is allied to the *taylorianus* complex and is probably most closely related to *R. strabo* (Brazier). From *strabo* and *taylorianus* it differs by having more convex and higher whorls. The peripheral angle of the body whorl in *gurgustii* is 82°, while in *strabo* it is 65°-70°, and in *taylorianus* it may be even more acute. From *taylorianus* it differs, in addition, by having a pink rather than a black lip.

Specimens examined: Louisiade Archipelago: Rossel Id. (MCZ; AM).

Rhynchotrochus (*Rhynchotrochus*) *gorenduensis* (Brazier).

Helix (*Geotrochus*) *gorenduensis* Brazier, 1886, *Proc. Linn. Soc. New South Wales,* 10:841 (Gorendu, Maclay Coast [Huon Peninsula], New Guinea).

Remarks: We copy the description given by Brazier. Nothing is known about this species. Dr. D. F. McMichael reports that the types are not in the Australian Museum, where most of Brazier's material was deposited. This species was never figured and, so far as we know, it has not been collected again.

Description: "Shell imperforated, trochus-shaped, rather thin, obliquely, finely striated and transversely wrinkled, flesh tinted or cream colour; ornamented with pinkish opaque spots and dots; spire rather conoid; whorls 5, convex, the last more convex, the first three apical whorls dark rose-pink, the fourth a little lighter in colour, the fifth slightly keeled in front, cream coloured, and marked with opaque pinkish spots and dots, base convex, sculptured same as above; aperture triangular, very much produced and contracted in front, constricted behind the aperture, interior bright pink, peristome blackish-purple, slightly reflected; the right margin descending in front, columellar margin flattened and expanded, tinged with brown, margins joined with a thin pink callus entering spirally into the interior of the aperture.

"Two specimens of this very pretty species were found by Baron Miklouho-Maclay. One was dead and weatherbeaten, the other was found with the animal alive. The Baron informs me that the animal was black, and that the back of the neck was brown.

"Alt. 15, greater diam. 25, lesser 20 mill."

Subgenus *POMPALABIA* Iredale.

Pompalabia Iredale, 1941, *Aust. Zool.*, 10:80 (type species, *Helix naso* v. Martens, original designation).

Shells medium in size, reaching up to 35 mm. in greater diameter, imperforate, conical in shape and banded, mottled or unicolourous. Outer lip descending with a deep papuinoid notch and with a rather broad basal area. Parietal wall usually with a thickened callous. Lip coloured a dark brownish black. Sculpture consisting of fine, wavy, incised lines or with fine spiral incised lines.

Remarks: We are holding provisionally the following species in the subgenus *Pompalabia* until the anatomy can be examined (other than that of *R. macgillivrayi* Forbes which is covered in this report, the anatomy of which is almost identical with that of *Rhynchotrochus taylorianus* (Adams and Reeve)). The shell differs in colour pattern and in the peculiar form of the outer lip. Other than *R. meekianus* (E. A. Smith) and *R. macgillivrayi* (Forbes) the parietal area has a rather thick callous.

Rhynchotrochus (*Pompalabia*) *meekianus* (E. A. Smith).

Plate 16, fig. 21.

Papuina meekiana E. A. Smith, 1905, *Ann. Mag. Nat. Hist.*, (7), 16:193, text fig. (Owgarra, on the Anabunga River, "two days" beyond Mafulu [Central Division], Owen Stanley Range (British New Guinea [Papua] about 8000 feet). [Holotype, BMNH no. 1905.10.23.86.]

Description: Shell subdepressed, trochiform, imperforate, finely sculptured, glossy and reaching 29 mm. (about 1⅛ inches) in greatest diameter. Ground colour a grayish white with some irregular patches of brownish black which are translucent. Outer lip a dark purplish black. Whorls 5, slightly convex and acutely keeled. Spire subdepressed and produced at an angle of 88°. Aperture subquadrate in shape, rostrate and with a deep V-shaped notch about midway on the upper half of the outer lip. Aperture cast at an angle of about 44° from the base. Parietal wall thinly glazed. Columella very short. Suture slightly indented. Sculpture consisting of numerous, irregular, incised lines, which are oblique above and spiral below the whorl periphery. Protoconch smooth, one whorl and white.

Height	Width	
19 mm.	29 mm.	Holotype.
17 mm.	27 mm.	New Guinea.

Remarks: This is a very rare species to judge by the few specimens in collections. It is transitional between *Rhynchotrochus* and *Pompalabia*. The colouration and the lack of a parietal callous relate it to *Rhynchotrochus* and the peculiar infolded lip as well as the deep papuinoid notch relate it to *Pompalabia*.

Specimens examined: Papua: Owen Stanley Range (UM); Owgarra, Anabunga River, Owen Stanley Range (BMNH).

Rhynchotrochus (*Pompalabia*) *naso* (v. Martens).

Plate 17, fig. 13-15. Plate 18, fig. 7-9.

Helix hundsteini [sic] Brazier, 1881, *Proc. Linn. Soc. New South Wales*, 5:637 [*nomen nudum*] (Base of Mt. Astrolabe, British New Guinea).

Helix naso v. Martens, 1883 (Feb.), *Jb. Dtsch. Malak. Ges.* 10:82 (Taburi, Astrolabe "Bay" [Mt.], Southeast New Guinea). [Holotype BM.]

Helix (Geotrochus) tapparonei Smith, 1883 (March), *Ann. Mag. Nat. Hist.*, (5), 11:190 ("D'entrecasteaux Is." [foot of Mt. Astrolabe]). [Holotype, BMNH no. 83.1.6.3.]

Helix hunsteinei Brazier, 1884, *Proc. Linn. Soc. New South Wales*, 9:805 [*nomen nudum*].

Helix (Papuina) naso v. Martens. Pilsbry, 1901, *Man. of Conchology*, (2), 7:56, pl. 2, fig. 32-35.

Papuina gemina Fulton, 1902, *Ann. Mag. Nat. Hist.*, (7), 9:183 (River Arva [Aroa], British New Guinea at 5000 feet). [Lectotype, BMNH no. 1902.5.28.37.]

Description: Shell subdepressed, trochiform, imperforate, finely sculptured, glossy and reaching 39 mm. (1⅝ inches) in greatest diameter. Ground colour a grayish white with or without spiral bands of pale brown, or with irregular radiating patches of purplish rose above the whorl periphery. Outer lip a brownish black both inside and outside. Parietal wall with a brownish black callous. Whorls 5, nearly flat sided and acutely keeled, the last whorl swollen behind the lip. Spire subdepressed and produced at an angle of 95°. Aperture auriculate, the outer lip with two deep lobes formed by the infolding of the papuinoid notch and usually with 1 or 2 small teeth at the base of the notch. Aperture cast at an angle of 22° from the base. Columella short, slightly arched. Base of the lip near the columella broad and having 2 to 4 small teeth on its inner margin. Sculpture consisting of numerous, irregular, incised lines, oblique above and spiral below the whorl periphery. Protoconch 1 to 1½ whorls and smooth.

Height	Width	
21 mm.	35 mm.	Holotype.
21 mm.	32.5 mm.	Inland from Port Moresby.
19 mm.	28.5 mm.	New Guinea.

Remarks: This species, similar to *R. meekianus*, appears to be very rare. It differs from *meekianus* by being larger, having a thickened parietal callous and small tooth-like processes on the base of the lip. *P. gemina* Fulton appears to be only a smaller race of this species.

Specimens examined: PAPUA: Inland from Port Moresby (MCZ); River Aroa (BMNH); Taburi, Mt. Astrolabe (BM).

Rhynchotrochus (Pompalabia) macgillivrayi (Forbes).

Plate 16, fig. 13-15; 22. Text fig. 6.

Helix macgillivrayi Forbes, 1852, [in] John Macgillivray, *Narrative of the Voyage of H.M.S. Rattlesnake*, London, 2:377, pl. 3, fig. 1 (Frankland Islands [Queensland, Australia]). [Holotype, BMNH no. 51.4.30.1; Paratype, MCZ no. 188107.]

Rhynchotrochus macgillivrayi extensior Iredale, 1938, *Aust. Zool.* 9: pt. 3, p. 92, pl. 12, fig. 3 (Annam River near Cairns, North Queensland, Australia). [Holotype, AM no. C.62671.]

Description: Shell subdepressed, trochiform, imperforate, finely sculptured, glossy and reaching 25 mm. (1 inch) in greatest diameter. Ground colour a yellowish brown and flecked with small black dots which when viewed from within the aperture are translucent. Outer lip black at

the point of infolding, then brown. The lip edge is white as well as its inner margin. The parietal wall is not calloused. The papuinoid notch deep and forming two unequal embayments, the lower rounded and small, the upper broad and angulated. Whorls 5, nearly flat sided and acutely keeled, the last whorl slightly swollen behind the lip. Aperture subauriculate. No teeth on lower point of the notch nor on the broad basal portion of the lip. Spire subdepressed and produced at an angle of about 80°. Sculpture consisting of numerous, fine, spiral incised lines. Protoconch of 1½ whorls, smooth and purple in colour.

Height	Width	
18 mm.	25.5 mm.	Tully Falls, Tully, North Queensland.
18 mm.	22.5 mm.	Frankland Island, Queensland (Paratype).
19 mm.	24 mm.	Yungaburra scrub, near Atherton, Queensland.
17 mm.	25.5 mm.	Yungaburra scrub, near Atherton, Queensland.

Remarks: This species differs from the other members of *Pompalabia* by its yellowish brown colour, by having small translucent black spots and fine, spiral, incised lines. The lack of a parietal callous relates it to *meekianus* but in all other respects they are quite dissimilar. The subspecies *extensior* does not differ in any of its characters from that of *macgillivrayi*. So far as known this species is limited to north Queensland.

The foot is white to light gray and smooth on the undersurface, darkening at the edges; upper surface charcoal-gray shading into a chestnut-brown behind the head. Mantle edge a purple-brown. Only a single specimen was available for dissection so that variation in the reproduction system could not be studied. As shown in figure 6, the reproductive system is similar to that of *R. taylorianus*. The strongly ribbed jaw and the marginal teeth of the radula are quite different from other species of *Rhynchotrochus* which have been studied.

Specimens examined: QUEENSLAND: Frankland Islands (AMNH; MCZ); Tully Falls, Tully (J. A. Grigg; MCZ); Lankelly Creek, McIlwraith Ranges; Redlynch (both MCZ); Yungaburra scrub, near Atherton (J. A. Marsh; R. Jackson; MCZ); Daintree River north of Cairns (AM).

REFERENCES

CLENCH, W. J., and R. D. TURNER, 1959. Two new genera of land molluscs (Papuininae) from the central highlands of New Guinea. *J. Malac. Soc. Aust.,* 3:4-9.

CLENCH, W. J., and R. D. TURNER, 1962. Monographs of the genera *Papustyla, Forcartia* and *Meliobba* (Papuininae: Camaenidae). *J. Malac. Soc. Aust.,* 6:3-33.

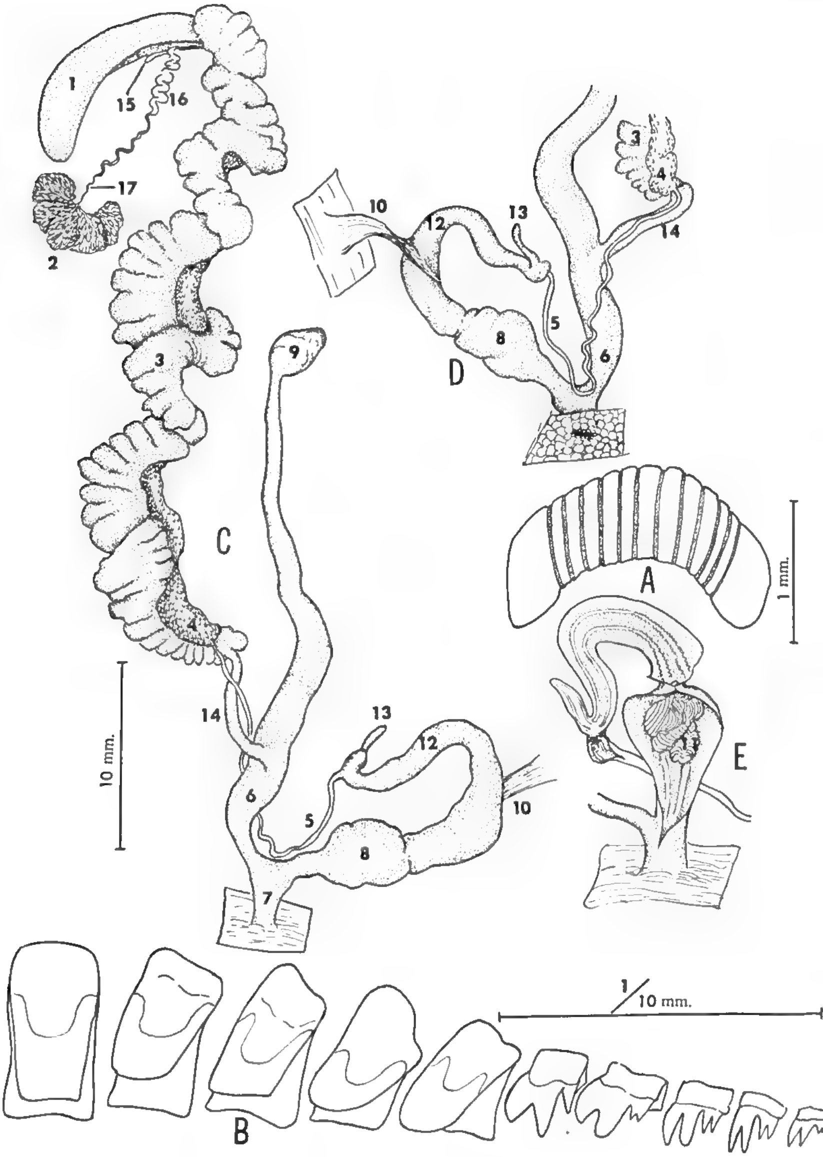
CLENCH, W. J., and R. D. TURNER, 1964. Monographs of the genera *Megalacron* and *Rhytidoconcha* (Papuininae: Camaenidae). *J. Malac. Soc. Aust.,* 8:36-71.

IREDALE, T., 1941. A basic list of the land Mollusca of Papua. *Aust. Zool.,* 10:51-94, pls. 3-4.

JUTTING, T. van B., 1933. Non-marine Mollusca from Dutch North New Guinea including an annotated list of the species of *Papuina*. *Nova Guinea,* 17:1-80.

PILSBRY, H. A., 1891. *Manual of Conchology,* (2), 7:3-81.

ZILCH, A., 1960. Die Typen und Typoide des Natur-Museums Senckenberg. *Arch. Molluskenk.,* 89:193-202.



Text figure 6.

Rhynchotrochus macgillivrayi (Forbes). Daintree River, North of Cairns, Queensland, Australia. A. Jaw with strong transverse grooves. B. Radular teeth. C. Reproductive system. D. Basal portion reversed to show normal position of vas deferens. E. Penis dissected. (See text figure 1 for labelling of reproductive system.)

EXPLANATION OF PLATES

PLATE 15

Fig. 1-2: *Papuina planogyra* Möllendorff. Near Constantinhafen, Astrolabe Bay, New Guinea. Lectotype, SMF 8641 [= *R. taylorianus* (Adams and Reeve)] (nat. size).

Fig. 3-4: *Papuina caputserpentis* Kobelt. Algalolo [Huon Peninsula], New Guinea. Lectotype, SMF 8656 [= *R. taylorianus* (Adams and size).

Fig. 5-6: *Papuina tayloriana genulabris* Möllendorff. Constantinhafen, New Guinea. Lectotype, SMF 8656 [= *R. taylorianus* (Adams and Reeve)] (nat. size).

Fig. 7-9: *Rhynchotrochus monticola* Iredale. Mt. Astrolabe [Central Division], Papua. Holotype, AM C. 62556 [= *R. taylorianus* (Adams and Reeve)] (Fig. 7, 2X; fig. 8-9, nat. size).

Fig. 10-12: *Rhynchotrochus sinucola* Iredale. Cloudy Bay, Papua. Holotype, AM C. 19510. [= *R. taylorianus* (Adams and Reeve)] (nat. size).

Fig. 13-15: *Rhynchotrochus praefectus* Iredale. Collingwood Bay, Northeast Papua. Holotype, AM C. 18887. [= *R. taylorianus* (Adams and Reeve)] (nat. size).

Fig. 16-18: *Rhynchotrochus vallicola* Iredale. Purari River, Papua. Holotype, AM C. 30643. [= *R. strabo* (Brazier)] (nat. size).

PLATE 16

All figures about ¾ X.

Fig. 1-3: *Helix katauensis* Tapparone-Canefri. Katau [Binaturi River, 10 miles west of Daru, Western Division, Papua]. Holotype, GM. [= *R. strabo* (Brazier)].

Fig. 4-6: *Helix rhynchonella* Tapparone-Canefri. Ansus Id., South Japen Id., West New Guinea. Holotype, GM. [= *R. taylorianus* (Adams and Reeve)].

Fig. 7-9: *Helix (Geotrochus) gurgustii* Cox. Rossel Island, Louisiade Ids. Holotype, AM C. 62668. [= *R. gurgustii* (Cox)].

Fig. 10-12: *Rhynchotrochus misima* (Iredale). Misima Id., Louisiade Ids. (Figured specimen of Iredale).

Fig. 13-15: *Rhynchotrochus macgillivrayi extensior* Iredale. Annam River, near Cairns, North Queensland. Holotype, AM C. 62671. [= *R. macgillivrayi* (Forbes)].

Fig. 16: *Helix tayloriana* Adams and Reeve. Locality unknown [Area about Port Moresby, Papua]. Holotype, BMNH 74.12.11.214. [= *R. taylorianus* (Adams and Reeve)].

Fig. 17: *Papuina tayloriana dampierensis* Fulton. Dampier Id., Northeast New Guinea. Holotype, BMNH 1922.2.24.35. [= *R. strabo dampierensis* (Fulton)].

Fig. 18: *Helix louisiadensis* Forbes. South-East Id., Louisiade Archipelago. Holotype, BMNH 51.11.24.7. [= *R. louisiadensis* (Forbes)].

Fig. 19: *Helix (Geotrochus) thomsoni* Smith. St. Aignan Id. [Misima Id.], Louisiade Islands. Lectotype BMNH 89.6.25.60. [= *R. misima* (Iredale)].

Fig. 20: *Helix (Papuina) albocarinata* Smith. Trobriand Ids. Holotype, BMNH 87.5.19.2. [= *R. albocarinatus* (Smith)].

Fig. 21: *Papuina meekiana* Smith. Owgarra, on the Anabunga River, two days beyond Mafulu, New Guinea. Holotype, BMNH 1905.10.23.86. [= *R. meekianus* (Smith)].

Fig. 22: *Helix macgillivrayi* Forbes. Frankland Ids., Queensland, Australia. Holotype, BMNH 51.4.30.1. [= *R. macgillivrayi* (Forbes)].

PLATE 17

Fig. 1-3: *Papuina taylorіana septentrionalis* I. and B. Rensch. Wide Bay, New Britain, Bismarck Archipelago. Holotype, BM. [=*R. rhynchotus* (Boettger)] (about 1½ X).

Fig. 4-6: *Papuina wiegmanni disjuncta* Rensch. Pomeo, Jacquinot Bay, New Britain, Bismarck Archipelago. Holotype, BM. [= *R. wiegmanni* (v. Martens)] (about 1½ X).

Fig. 7-9: *Papuina wiegmanni conjuncta* Rensch. Talassea and Ulamona, north coast of New Britain, Bismarck Archipelago. Holotype, BM. [=*R. wiegmanni* (v. Martens)] (about 1½ X).

Fig. 10-12: *Helix (Geotrochus) wiegmanni* v. Martens. Tuom Id., Siassi Ids., Bismarck Archipelago. Holotype, BM. [= *R. wiegmanni* (v. Martens)] (about nat. size).

Fig. 13-15: *Helix naso* v. Martens. Taburi, Astrolabe Mt., British New Guinea. Holotype, BM. [= *R. naso* (v. Martens)] (1.3 X).

PLATE 18

Fig. 1-3: *Henga deliciosa* Iredale. Laughlan Island, Woodlark Islands. Holotype, AM C. 62666. [= *R. woodlarkianus* (Souverbie)] (nat. size).

Fig. 4-6: *Rhynchotrochus mysticus* Iredale. Trobriand Islands. Holotype, AM C. 62658. [= *R. albocarinatus* (Smith)] (nat. size).

Fig. 7: *Helix (Geotrochus) tapparonei* Smith. Foot of Mt. Astrolabe, Papua. Holotype, BMNH 83.1.6.3. [=*R. naso* (v. Martens)] (nat. size).

Fig. 8-9: *Papuina gemina* Fulton. River Arva [Aroa], British New Guinea at 5,000 ft. Fig. 8. Lectotype, BMNH 1902.5.28.37; Fig. 9. Paratype, BMNH 1902.5.28.38. [= *R. naso* (v. Martens)] (nat. size).

Fig. 10: *Helix (Papuina) rollsiana* Smith. Fergusson Island, d'Entrecasteaux Ids. Holotype, BMNH 83.3.23.3. [= *R. rollsianus* (Smith)] (nat. size).

Fig. 11-13: *Geotrochus trobriandensis* Hedley. Trobriand Ids. Lectotype, Queensland Museum M02810. [= *R. albocarinatus* (Smith)] (1.5X).

Fig. 14-16: *Helix (Geotrochus) yulensis* Brazier. Yule Island, Papua. Lectotype, AM C. 62382. [= *R. yulensis* (Brazier)] (1.5X).

PLATE 19

Fig. 1-2: *Papuina kubaryi* Möllendorff. Constantinhafen [Astrolabe Bay] German New Guinea. Lectotype, SMF 8635a. [=*R. kubaryi* (Möllendorff)] (nat. size).

Fig. 3: *Papuina kubaryi albina* Möllendorff. Constantinhafen. [Astrolabe Bay] German New Guinea. Lectotype, SMF 8637. [= *R. kubaryi* (Möllendorff)] (nat. size).

Fig. 4-5: *Papuina rhynchota* Boettger. Wide Bay, New Britain, Bismarck Archipelago. Lectotype, SMF 5937. [= *R. rhynchotus* (Boettger)] (nat. size).

Fig. 6-8: *Helix (Geotrochus) strabo* Brazier. Katau River [Binaturi River, near Daru, Papua]. Lectotype, here selected, AM C. 62381. [= *R. strabo* (Brazier)] (1.6X).

Fig. 9-11: *Rhynchotrochus extraneus* Iredale. Kerema, Gulf of Papua. Holotype, AM C. 62657. [= *R. strabo* (Brazier)] (fig. 9, 1½X; figs. 10, 11, nat. size).

Fig. 12: *Papuina jacunda* Fulton. German New Guinea. Holotype, BMNH 1902.5.28.39. [=*R. jacundus* (Fulton)] (2X).

Fig. 13-14: *Rhynchotrochus jacundus* Fulton. Northeast New Guinea. MCZ 66376. (1.8X).

Fig. 15: *Helix millicentae* Cox. Louisiade Ids. Paratype, MCZ 191975. [= *R. louisiadensis* (Forbes)] (2X).

Fig. 16: *Helix millicentae* Cox. Louisiade Ids. Lectotype, AM C. 62380. [= *R. louisiadensis* (Forbes)] (2X).

PLATE 20

Fig. 1: *Rhynchotrochus taylorianus* (Adams and Reeve). Botanic Garden, Lae, Northeast New Guinea. MCZ 224942. (ex Australian Mus.) (1.8X).

Fig. 2: *Rhynchotrochus taylorianus* (Adams and Reeve). Milne Bay, Papua. MCZ 191228. (1.8X).

Fig. 3-4: *Rhynchotrochus taylorianus* (Adams and Reeve). Orokola, Gulf Division, Papua. MCZ 191971. (1.8X).

Fig. 5: *Rhynchotrochus taylorianus* (Adams and Reeve). Milne Bay, Papua. MCZ 191228 (1.8X).

Fig. 6-7: *Rhynchotrochus taylorianus* (Adams and Reeve). Ali Id., 18 miles East of Aitape, Northeast New Guinea. MCZ 192235 (1.8X).

Fig. 8-11: *Papuina wiegmanni parvula* (Rensch). French Id. [Unea Id.], Vitu Ids., Bismarck Archipelago. Paratypes, MCZ 248799. [= *R. wiegmanni* (v. Martens)] (1.7X).

PLATE 21

Fig. 1-2: *Rhynchotrochus strabo* (Brazier). Maclatchie Point, Gulf Division, Papua. ANSP 31550 and 31553. (2X).

Fig. 3: *Papuina tayloriana dampierensis* (Fulton). Dampier Id. [Northeast], New Guinea. Paratype, ANSP 127765. [= *R. strabo dampierensis* (Fulton)] (2X).

Fig. 4: *Rhynchotrochus strabo* (Brazier). Albert Mts., Gulf Division, Papua. MCZ 191348. (2X).

Fig. 5-6: *Rhynchotrochus kubaryi* (Mllf). Tawarin, near Hollandia, West New Guinea. MCZ 191233. (1.7X).

Fig. 7: *Rhynchotrochus kubaryi* (Mllf). Koeama River, east of New Pionierbivak, West New Guinea. MCZ 253178. (1.7X).

PLATE 22

Fig. 1-3: *Papuina williamsi* Clench and Archer. Omarakana, Central Kiriwina, Trobriand Ids., New Guinea. Fig. 1, Holotype, MCZ 110396; Fig. 2 and 3, Paratypes, MCZ 111149. [= *R. williamsi* Clench and Archer] (2X).

Fig. 4-6: *Papuina williamsi atalanta* Clench. Omarakana, Central Kiriwina, Trobriand Ids., New Guinea. Fig. 4, Holotype, MCZ 111151; Fig. 5 and 6, Paratypes, MCZ 111152. [=*R. williamsi* Clench and Archer] (2X).

Fig. 7-10: *Rhynchotrochus woodlarkianus* (Souv.). Woodlark Id., New Guinea. Fig. 7-8, MCZ 225345; Fig. 9-10, MCZ 225346.

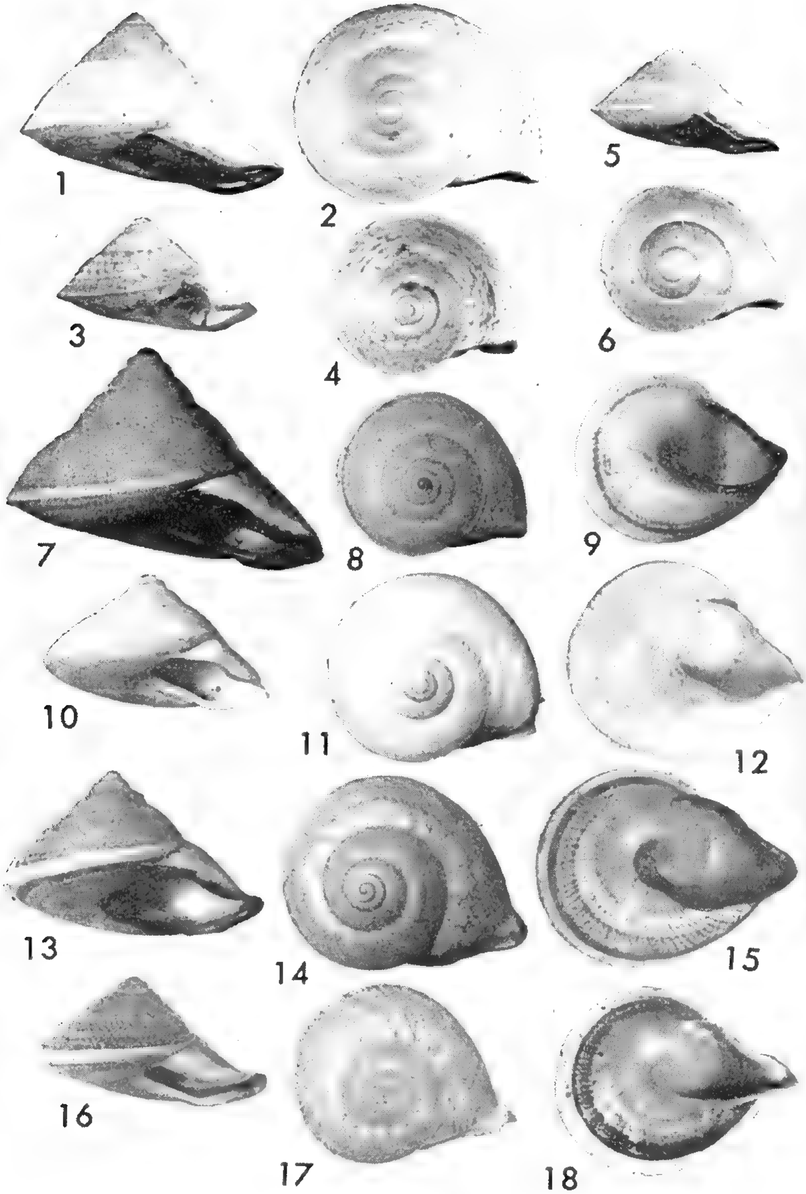


PLATE 15

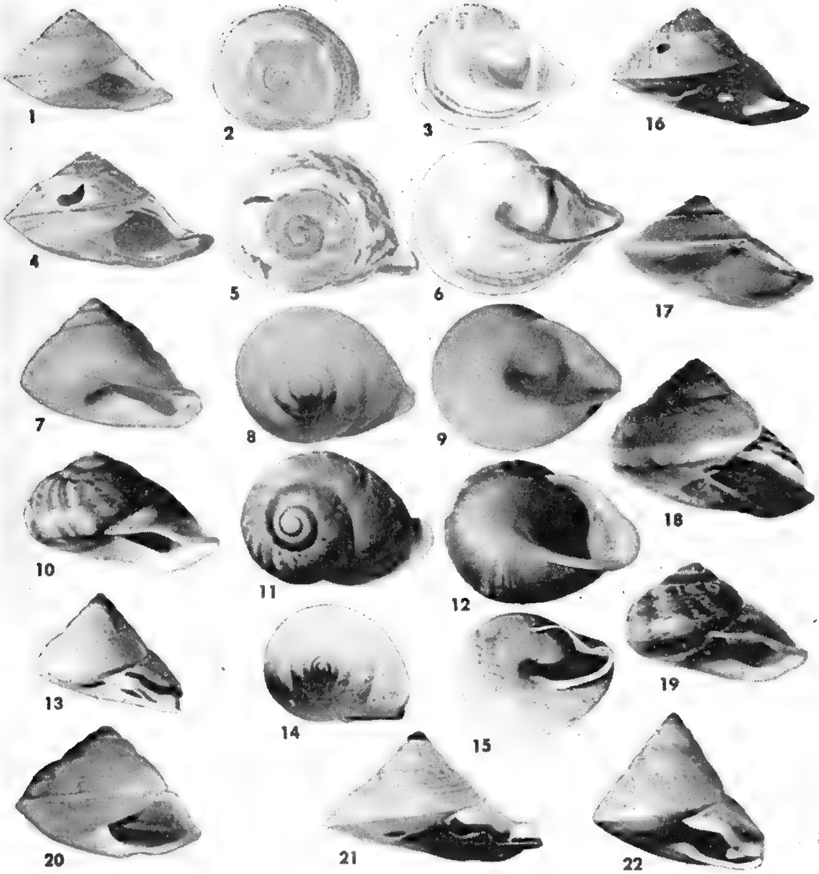


PLATE 16

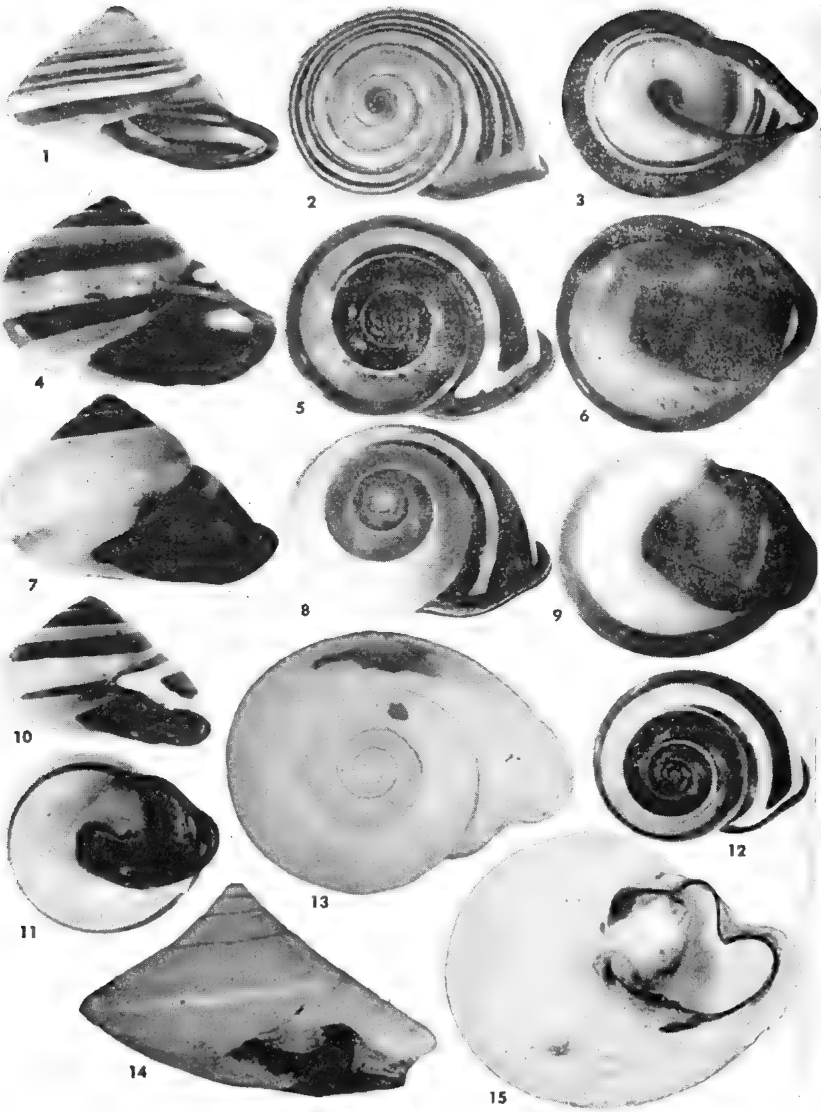


PLATE 17

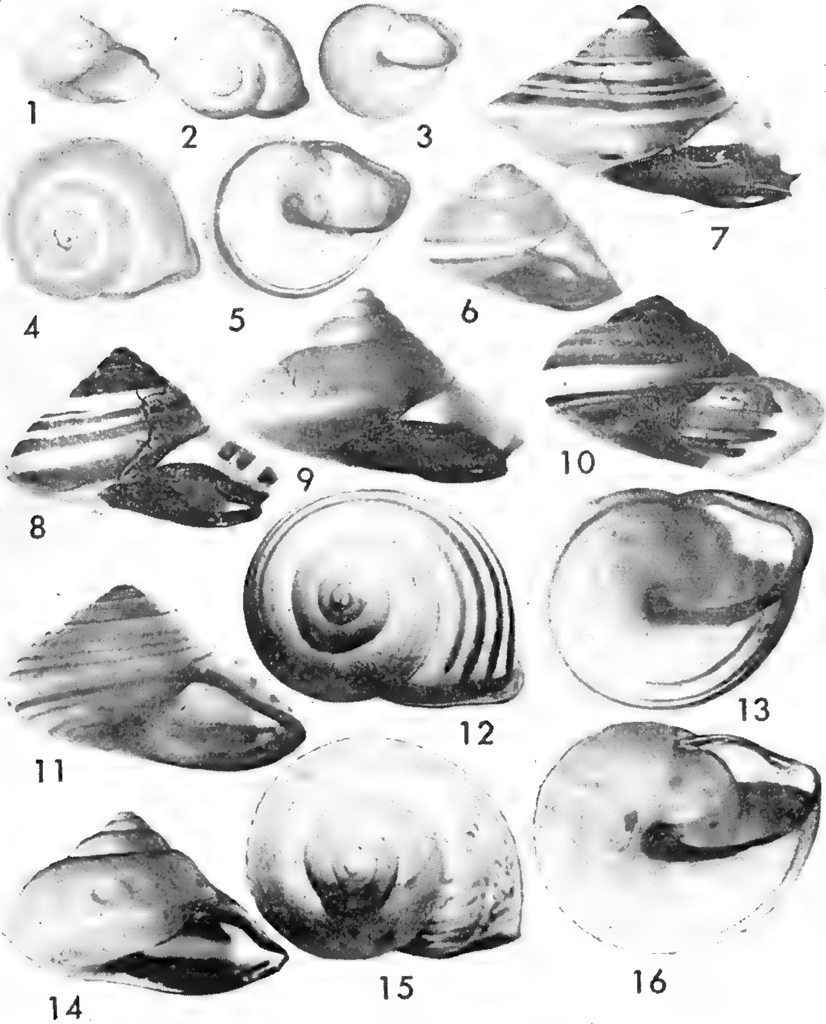


PLATE 18

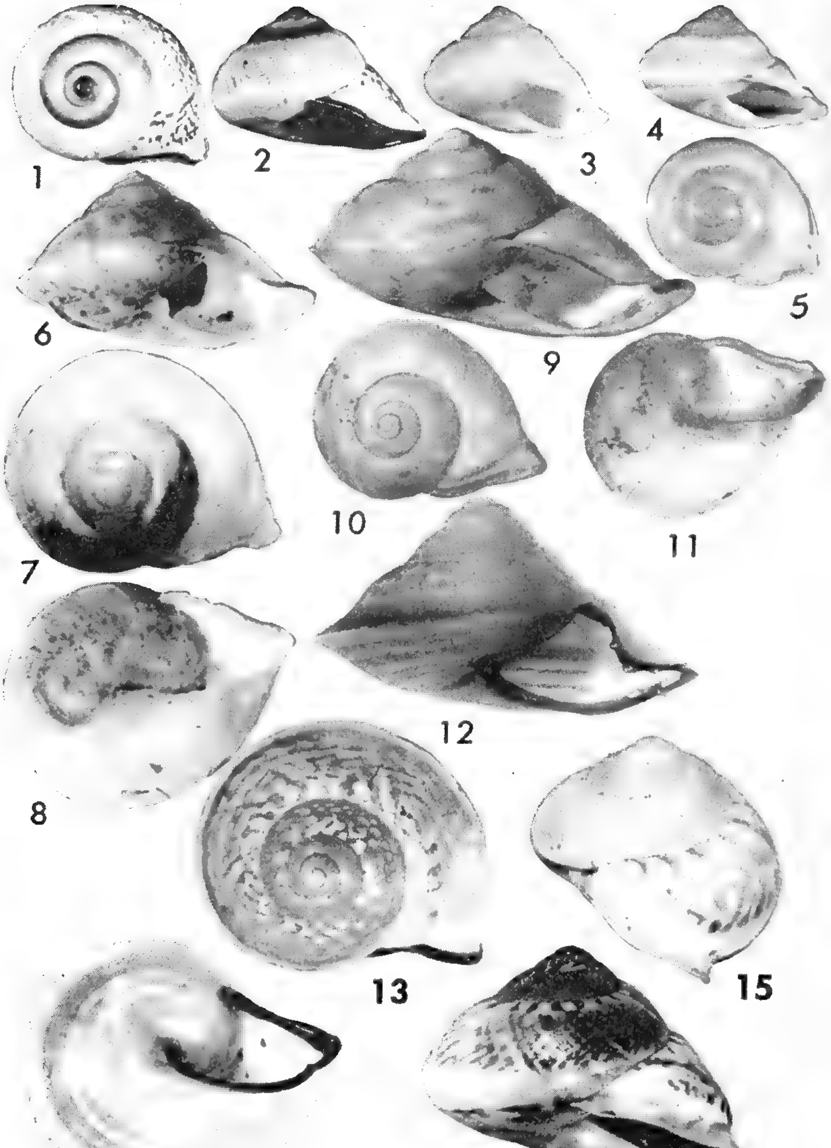


PLATE 19

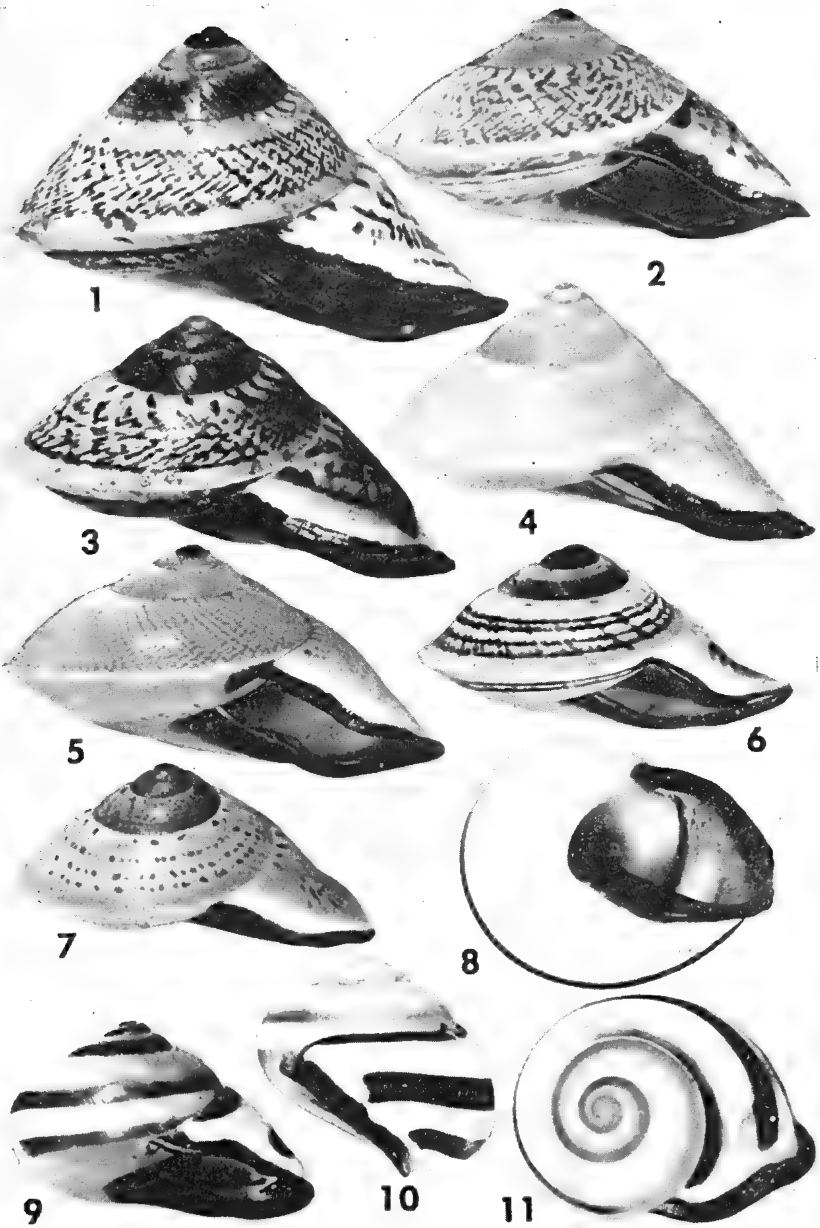


PLATE 20

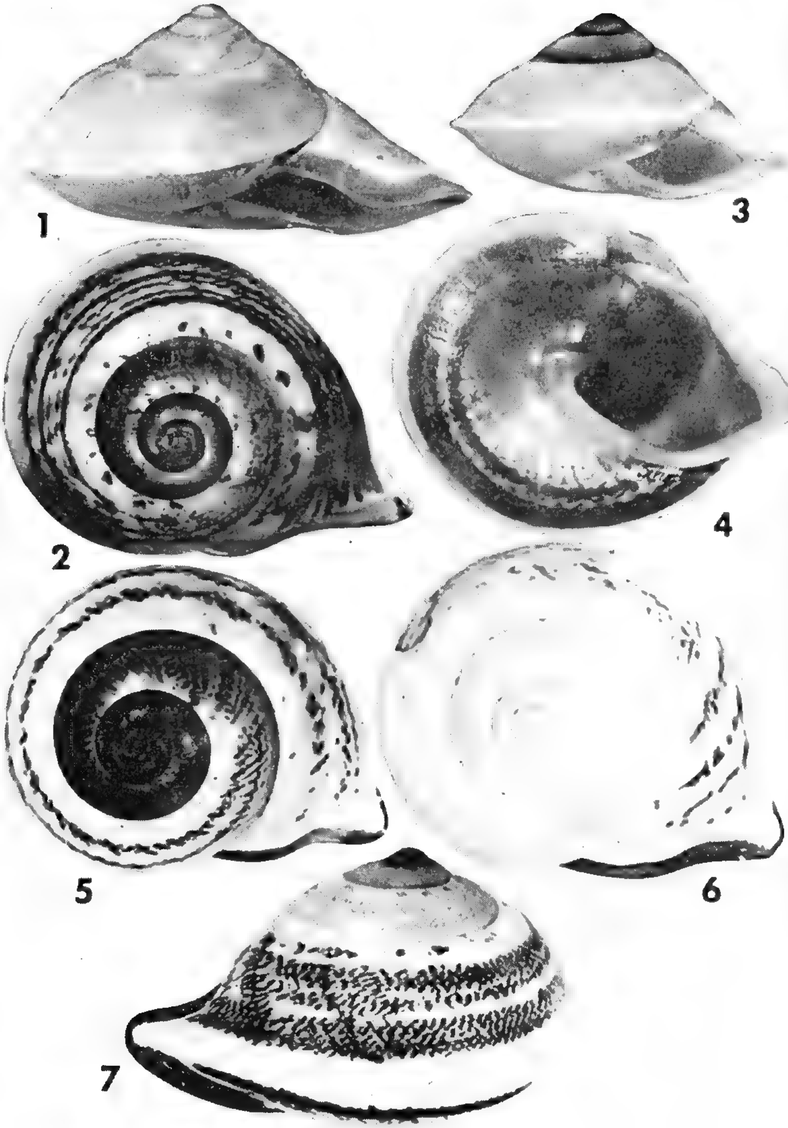


PLATE 21

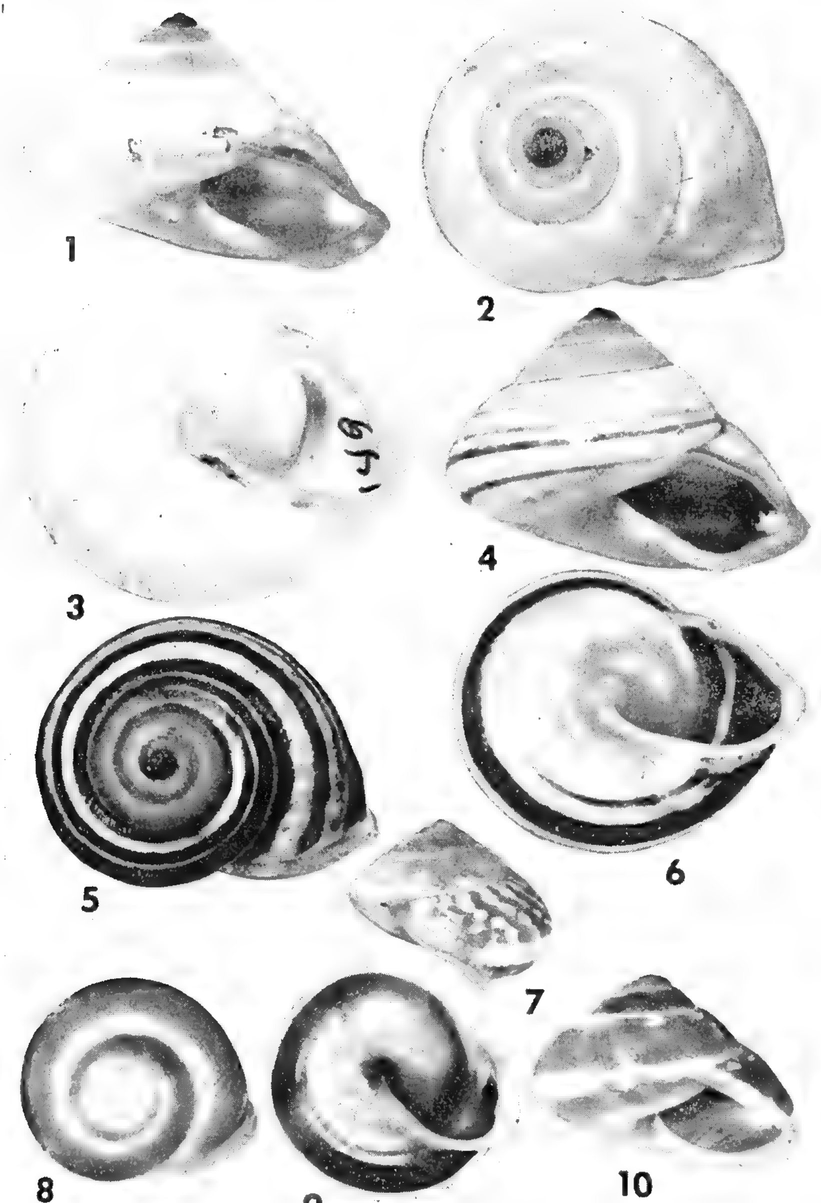


PLATE 22

SOME OPISTHOBRANCHS FROM SOUTHERN QUEENSLAND

By ROBERT BURN*

Text figures 1-14.

SUMMARY

Of 14 opisthobranch species reported from southern Queensland, two are new species, *Chelidonura conformata, Placida fralila* and nine are new records for the State. The nomenclature of the other species is brought up to date.

INTRODUCTION

In a recent paper, Kenny (1960) recorded thirty-one species of opisthobranchs collected by himself and others in Queensland waters. This is by no means the total number of opisthobranchs to be found in the area. From a small collection taken at Greenmount, Rainbow Bay, and Pt. Danger (Schnapper Rocks), Coolangatta, a further eleven species can be added to the Queensland fauna. Among these are two new species and one new record to the Australian fauna. An additional species is added from the Capricorn Group.

This research is part of a study of the Australian Opisthobranchia. The writer gratefully acknowledges the assistance of a grant from the Science and Industry Endowment Fund, C.S.I.R.O., Melbourne. The abbreviations Q.M., A.M. and N.M.V. are for Queensland Museum, Australian Museum and National Museum of Victoria respectively.

SYSTEMATIC SECTION

ORDER CEPHALASPIDEA
SUBORDER BULLACEA
FAMILY BULLIDAE

Bulla ovulum Angas.

Text figs. 1-4.

Bulla ovulum Angas, 1867:227, ex Gould ms.
Bulla angasi Pilsbry, 1893:347.
Bulla punctulata Hedley, 1910:370, not of A. Adams, 1850.
Quibulla angasi. Iredale, 1929:350, pl. 38, fig. 8.
Quibulla ovulum. Iredale, 1937:258; Iredale and McMichael, 1962:88.

Material: South end of Rainbow Bay, Coolangatta, 2 September, 1964, 1 dead shell, R. Burn leg.; Q.M. reg. no. MO2947.

Ex pisces, Capricorn Group, January, 1959, 1 shell with remains of animal, P. Colman leg.; A.M. C.62872.

Comments: The two shells are not greatly alike in shape or solidity, but the patterns are nearly identical. The Rainbow Bay shell (text fig. 1a-2a) is very solid, well rounded in shape and mottled brown with three dark brown bands; it is 20 mm. long and 13.5 mm. broad. The ex pisces shell (text fig. 1b-2b) has a more fragile appearance, thin lip, more

* Hon. Associate in Conchology, National Museum of Victoria, Melbourne, Victoria.

elongated cylindrical shell and is mottled pale brown with two obsolete dark brown bands; it is 20 mm. long and 12 mm. broad.

The jaws are large, brown in colour and composed of closely packed hexagonal pillars. The radula (text fig. 3) has 26 rows of 1.2.1.2.1 teeth. The rachidian (*a*) is broad, crescent shaped and taping to the sides, with a small single or double median cusp and one large and four smaller denticles each side. First lateral tooth with long cusp and three denticles each side, second lateral with seven denticles. Marginal plate longer than wide, five sided. The oldest six rachidian teeth lack lateral and marginal teeth. The three gastral plates are dark brown above, greenish with two white spots below. Shape pyramidal with folds at each end and a pair of ridges on one side. A few horny spines are found in front of and behind the gastral plates. A large conical oesophageal diverticulum projects from the oesophagus behind the pharynx.

The penis (text fig. 4) is exceedingly long (10 mm. overall). The outer one-third is a slender atrium (*d*), the inner two-thirds is wider and contains the penis (*b*) The distal bulb is pear-shaped and contains the transverse intensely coiled prostate duct (*c*). There is no terminal caecum as in *B. gouldiana* Pilsbry, 1893 (Marcus, 1961:5, pl. 1, fig. 4).

Discussion: Iredale (1937:259) states that the shell of *B. ovulum* is never banded, merely mottled and clouded with dark and light brown. Otherwise, I believe the present specimens to be identical with the Sydney Harbour species and a new record by this name at least for Queensland. Hedley regarded this species as a synonym of *B. punctulata* A. Adams (1850:577; Iredale, 1929:350) and recorded it under the latter name in his Queensland list (1910:370).

In the literature, four different species have their radulae figured. *B. striata* (Bruguiére, 1792) (Marcus, 1955, pl. 1, fig. 3), *B. gouldiana* Pilsbry, 1893 (Marcus, 1961, pl. 1, fig. 3), *B. ampulla* (Linné, 1758) and *B. vernicosa* Gould, 1859 (Habe, 1950, pl. 3, fig. 15, 16) each have the rachidian curved and truncate at the sides, not crescentic and tapering. The marginal plate appears to be larger than in any of these species.

According to the literature the penis of *B. ovulum* has a longer atrium than other species of the genus (Marcus, 1957:395, fig. 6; 1961:5, pt. 1, fig. 4).

Bulla orientalis Habe.

Text figs. 5-8.

Bulla punctulata Hedley, 1910:379, non A. Adams, 1850.

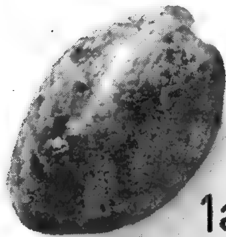
Bulla peasiana Kuroda, 1941:133, pl. 3, fig. 47, non Pilsbry, 1893.

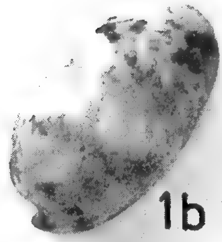
Bulla orientalis Habe, 1950:21, pl. 3, fig. 10.

Material: Ex pisces, Capricorn Group, January, 1959, 1 shell with remains of animal, P. Colman leg.; A.M. C.63082.

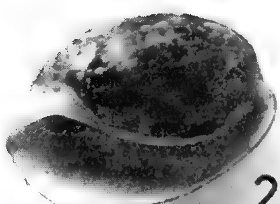
Comments: The only shell (text fig. 5-6) is thin, the lip fragile, well rounded; the colour is pinkish brown with numerous rounded white spots which are shaded by dark brown spots and tails on the left. It measures 16.5 mm. long and 10 mm. wide.

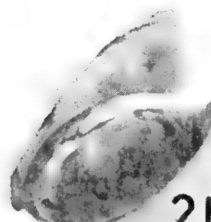
The jaws are small, dark brown and composed of smaller and shorter closely packed hexagonal elements. The radula (text fig. 7) has the formula 20 rows of 1.2.1.2.1, the oldest two rows of which lack marginals. The rachidian (*a*) is broad, well curved with truncated sides. The cusp is larger than in *B. ovulum* as are also the first two denticles on each side.


1a


1b


5


2a


2b


6

The remaining three denticles on each side become smaller. The first lateral has three denticles each side of the cusp, the second six denticles. The marginal plate is small, quadrate. The gastral plates are rather sharper and more ridged than in *B. ovulum*; two pairs of white spots mark the bases. A few horny spines are present between the ends of the gastral plates. The gizzard was full of foraminiferal sand.

The male copulatory organ (text fig. 8) has a shorter atrium (*d*) than in *B. ovulum*. The penis (*b*) is wider and three times as long as the atrium. The distal bulb is slender and contains vertical folds of the prostate duct (*c*) in its low part. A bigger terminal sac or seminal vesicle (*i*) as in *B. striata* (Marcus 1957:395, fig. 6 *cn*) fills the inner part of the distal bulb.

Discussion: This shell is more ovoid than the type figure (loc. cit) and only half the length. The colour patterning is, however, so distinctive as to exclude any other identification. Without the examination of Hedley's and Iredale's Queensland and New South Wales "punctulate" species (Iredale, 1929:350), it is impossible to say to which *B. orientalis* belongs. Certainly *B. orientalis* is a good species and its patterning will allow its ready recognition. The question of the "punctulate" species of eastern Australia deserves early attention.

SUBORDER PHILINACEA

FAMILY DORIDIIDAE

Doridium taronga (Allan).

Text figs. 9-10.

Aglaia taronga Allan, 1933:444, pl. 56, fig. 1-3.
Aglaia taronga Allan, 1950:217.
Aglaia taronga. Burn, 1957:117, fig. 2.
Doridium taronga. Iredale and McMichael, 1962:89.
Doridium taronga. Burn, 1965: in press.

Material: South end of Rainbow Bay, Coolangatta, September. 1964, 1 specimen crawling in shallow pool at low tide, Q.M. reg. no. MO.2948.

Description: The living slug (text fig. 9) was 14 mm. in length. The body colour was pale fawn everywhere with brown and darker reticulations that in places hide the body colour. There were two short curved yellow stripes each side of a long pale fawn median stripe on the cephalic shield. The edges of the parapodia were brown, submarginally yellow. The parapodia and sole were paler than the dorsal surface.

The animal was rather elongate with small parapodia, a long posteriorly pointed and upturned cephalic shield and a shorter visceral hump. Two folds of flesh project posteriorly from the visceral hump; of these the left one was longer and broader.

The male copulatory organ (text fig. 10) of a large example from Rosebud, Port Phillip Bay, Victoria (leg. F. and M. Murray, 15.IV.1963) was examined by dissection. In outward appearance, the organ is very similar to that of *Doridium ceylonica* (White, 1946:171, fig. 5). In detail it is far more complex. A thin walled transparent penial sheath envelops the whole copulatory organ except for the projecting prostate gland (*c*). The penis (*b*) is a large spade-like lamina, folded twice upon itself. The major fold attains the male aperture. The minor fold is much shorter.

The edge furthermost from the minor fold is rather thicker than elsewhere and shortly inside the margin is markedly hollowed to form a seminal furrow (*h*). The inner end of the groove disappears into the penis at the base of posterior coils. The coils (*f*) are two in number but unlike those of *D. ceylonica* they have no "segmented" outer side. Instead the coils are an open spiral channel with closely folded over walls.

A broad flat duct (*g*) leaves the base of the coils in the direction of the male aperture, then skirts the anterior edge of the penial sheath to open along the inner end of the major penial fold. The glandular prostate gland (*c*) projects freely beyond the penial sheath. Its duct is stout and follows the same course as the duct from the coils. The whole penial lamina is translucent; in the integument small straight spicules are visible, set closely but haphazardly just below the surface. In penial tumescence these spicules would protrube at least so far as to provide a sandpaper surface.

Discussion: *D. taronga* is a rarity among the Australian Doridiidae. Other than the type specimen from Sydney Harbour (Allan, 1932) there are only three known specimens, respectively two from Port Phillip Bay, Victoria (Burn, 1957:117; 1965: in press), and the present specimen. The colour pattern distinguishes the species from others of the genus presently recorded, i.e., red *D. sanguinea* (Allan, 1933:445), black *D. cyanea* Martens, 1880 (Allan, 1950:217) and small black *D. queritor* (Burn, 1951:117).

It is indeed unfortunate that so little is known of the anatomy of the Doridiidae. Colour which might be so distinctive and specific in life is so readily lost in preserved animals. From a study of the literature on this family, the form of the male copulatory organs appears to have decisive specific value. Thus it is necessary only to consider *D. taronga* with *D. ceylonica* which is warm grey with lighter blotches, anterior shield marbled with dark lines, anterior edge of head and foot edges dark (White, 1946:167). Though very similar in gross design, the male copulatory organs of *D. ceylonica* are more simple in detail.

D. taronga has a large pad of sensorial cilia on each side of the mouth as is so often depicted in species of *Chelidonura*. *D. queritor* (Burn, 1957:117) also has pads of sensorial cilia. It would seem therefore that this characteristic must be regarded as of family value.

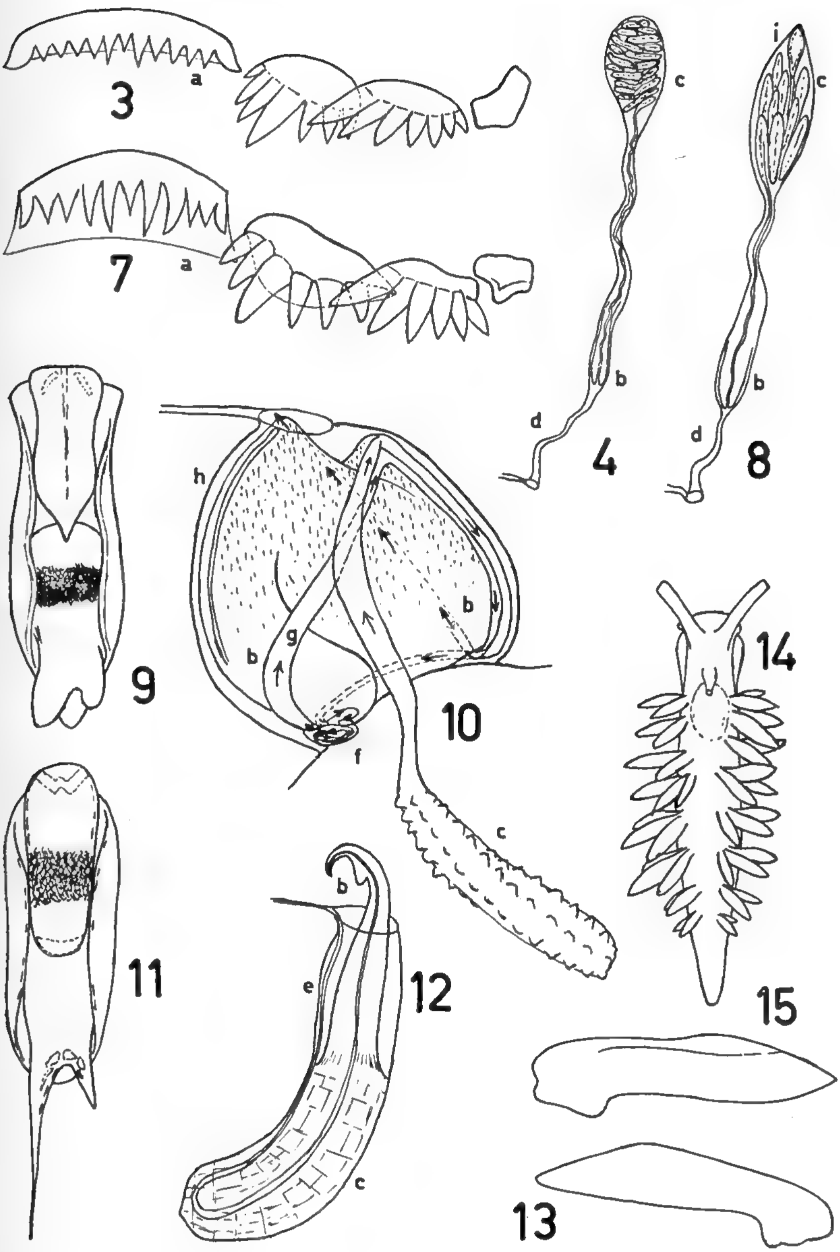
D. taronga is a new record for Queensland. *D. marmorata* Smith (1884:87) which is listed among the Queensland fauna (Hedley 1910:370) is a synonym of the common Indo-Pacific *D. cyanea* Martens, 1879 (Macnae, 1962:193).

Chelidonura conformata sp. nov.

Text figs. 11-12.

Material: Pt. Danger (Schnapper Rocks), Coolangatta, August, 1964, 1 specimen (holotype) crawling on sand bottom of a high water pool, Q.M. reg. no. MO.2949.

Description: The living specimen (text fig. 11) was about 15 mm. in length including the 6 mm. long whip-like tail flagellum. As preserved, it is 11 mm. long, 3.6 mm. wide, 3 mm. high and the tail is 3.5 mm. long. The body was brown over all the exposed surfaces, including the sole, everywhere with a dark brown fine reticulate patterning. Across the anterior of the head was a broad white W-shape mark, the tail of the cephalic shield bears a wide transverse white bar and the base of the tail flagellum is dorsally white. A few small patches of dark red


3
a
7
a
c
i
c
b
d
4
b
d
8
9
h
b
g
b
f
10
c
11
b
e
12
c
14
15
13

were spaced along the anterior lateral margins of the cephalic shield, along the parapodial margins and about the base of the tail flagellum. The preserved holotype is a dull brown with lighter patches where formerly white.

The animal had the usual slender form of *Chelidonura* with an exceptionally long whip-like left tail flagellum. The shell was not examined owing to decalcification in formalin. The tip of the penis protruded from the male aperture to the right of the mouth. After dissection, the whole male copulatory organ (fig. 12) is seen as a small cylindrical apparatus from which projects the tapering penis (*b*) with curled tip below which is developed a fleshy keel-like barb. The seminal groove (*e*) runs as a high walled ciliated furrow along the wall of the penial sheath then turns and runs along the side of the penis. The base of the penis is soft and pulpy; this is evidently the prostate gland (*c*).

Discussion: *C. conformata* is the first record of this genus from Queensland and only the third from Australia. *C. hirundinina* (Quoy and Gaimard, 1833) is recorded from Sydney Harbour, New South Wales, as *C. adamsi* Angas (1867:116), and Allan (1950:218) reported *C. fulvipunctata* Baba (1938:3) from Angourie, northern New South Wales. The latter record probably covers several species as the writer has in his collection at least four species of *Chelidonura* from this locality.

C. conformata closely resembles *C. inornata* Baba (1949:22, 124) which occurs on the northern coastline of New South Wales at Minnie Waters and Angourie. This species has blue spotting on the parapodia and sole, black cephalic shield and visceral hump and a white and yellow anterior margin to the head. Its penis also differs from that of *C. conformata* by being conical with a deep channel-like seminal groove. The shell of *C. inornata* is large, solid and dark red.

Though convenient, the allocation of species to either *Doridium* (no tail flagella) or *Chelidonura* (either two or one tail flagella) is often arbitrary as there are no other decisive characteristics to justify the generic separation. Even Marcus' diagnostic of *Chelidonura,* penis absent or warty (1961:8) applies equally well to *Doridium* (vide White, 1946; figs. 8, 13). As several different schemes of penial organization are known in the family, a sectional division based on this could be advanced. However, until further study of the Australian species is undertaken, no attempt to define sections will be attempted. It is enough to say that *C. conformata* and *C. inornata* belong to one section, *D. lineolata* (H. & A. Adams, 1854; White, 1945:97) and *C. phocae* Marcus (1961:8) to another.

FAMILY ANASPIDEA

ORDER APLYSIIDAE

Aplysia (*Pruvotaplysia*) *parvula* Mörch.

Aplysia parvula Mörch, 1863:22.

Aplysia norfolkensis Sowerby, 1869, pl. 10, fig. 42.

Aplysia norfolkensis. Allan, 1950:212, fig. 3.

Aplysia (*Pruvotaplysia*) *parvula*. Eales, 1960:287.

Material: Greenmount, Coolangatta, August, 1964, 3 specimens browsing on brown algae in rock pools, Q.M. reg. no. MO2950.

Discussion: A new record for Queensland. This tropical and subtropical species has a circum-global distribution that already includes New

South Wales, Victoria, Tasmania and South Australia. The Queensland animals are light brown in colour with white punctae and mottles. The parapodia and foot are margined with black and white.

Aplysia (*Varria*) *dactylomela* Rang.

Aplysia dactylomela Rang, 1828:56, pl. 12.

Aplysia tigrina Rang, 1828:57.

Aplysia angasi Sowerby, 1869, pl. 8, fig. 35.

Tethys tigrina. Hedley, 1910:370.

Aplysia angasi. Hedley, 1923:314, pl. 33.

Aplysia angasi. Allan, 1950:212, pl. 28, fig. 13.

Aplysia dactylomela. Eales, 1960:307, frontispiece.

Material: Greenmount and south end of Rainbow Bay, Coolangatta, August, 1964, many specimens browsing on alga on rocks at low tide, Q.M. reg. no. MO2951.

Discussion: Hedley has already reported this species as *Tethys tigrina* from Queensland (1910:370). His later colour plate of a Sydney specimen (1923, pl. 33) shows the distinctive black rings on the outside of the parapodia and the black patches on the innerside. The present specimens had a suffusion of pink along the parapodial edges.

Aplysia (*Varria*) *extraordinaria* (Allan).

Tethys extraordinaria Allan, 1932:314, pl. 35, fig. 7-8.

Aplysia extraordinaria. Eales 1960:312.

Material: South end of Rainbow Bay, Coolangatta, August, 1964, specimen crawling on mud bottom of shallow pool at low tide, Q.M. reg. no. MO2952.

Description: The living slug was only 30 mm. long. The body was pale brown with stellate yellowish punctae on the sides and body and small cream patches along the parapodial edges. A few small darker areas were scattered over the body and the shell mantle was brownish with dark and light rays. The pharynx shows in the neck as an orange mass.

The animal is slender with large blade-like oral tentacles, a long neck, small short rhinophores at mid-length of the neck and large thin parapodia joined low down upon the tail. The shell mantle and anal siphon are small.

Discussion: The animal swam freely in a tank of water. To do this the front edge of the oral tentacles are lifted to a near horizontal plane, the neck is flexed and the parapodia start their front to rear synchronous flappings or undulations.

A. extraordinaria is hitherto known in Australia only from Sydney Harbour and Port Hacking. This record extends its range considerably northward. The species is particularly characterized by its long slender neck with small short rhinophores at mid-length and the large swimming parapodia joined low down upon the tail. The shape of the radular teeth appears to be of a specific value also (Eales, 1960:314, fig. 23, *d*).

Aplysia (*Aplysia*) *juliana* Quoy and Gaimard.

Aplysia juliana Quoy and Gaimard, 1832:309.

Aplysia iuliana. Eales, 1960:363.

Material: Pt. Danger (Schnapper Rocks) and Greenmount, Coolangatta, August, 1964, 5 specimens browsing on algae in rock pools, Q.M. reg. no. MO2953.

Discussion: Eales (1960:386-387) lists the British Museum (Natural History) specimens of *A. juliana* and therein first reported the species from New South Wales and Victoria. *A. juliana* is a tropical and subtropical circum-global species. The present specimens were dark reddish-brown in colour with white punctae on the sides and body; the sole was darker and posteriorly developed into a sucking disk. A white line on each side of the head runs from the oral tentacle base to the rhinophore base and surrounds the eye. The parapodia are joined high up over the tail.

ORDER SACOGLOSSA

FAMILY ELYSIIDAE

Elysia australias (Quoy and Gaimard).

Text fig. 13.

Actaeon australis Quoy and Gaimard, 1832:317, pl. 24, fig. 18-20.
Elysia coodgeensis Angas, 1864:69, pl. 6, fig. 9.
Elysia australis. Allan, 1947:438.
Elysia australis. Allan, 1950:225.

Material: Pt. Danger (Schnapper Rocks), Coolangatta, August, 1964, 4 specimens, Q.M. reg. no. MO2954.

Description: Alive, this species grows to 15 mm. in length though generally it is less than 10 mm. The colouration is as shown by Angas (1864, pl. 6, fig. 9), body everywhere green, parapodia edged with black, inside which is a row of white patches. The rhinophores and tail are tipped with black, and there is a short median stripe of black on the head between the rhinophores. Some specimens observed but not preserved were very dark green in colour.

The body is slender and the parapodia long, narrow and not greatly undulated at the edges. Rhinophores rather long, slender and auriculate. The anal papilla opens at the right anterior side of the pericardium.

The radula consists of 8 teeth in the ascending series and 23 in the descending. Each tooth (text fig. 13) is entirely smooth, very slender in plan and chisel pointed in profile.

The penis is long, tapering and coiled in a circle. It lies in a large pouch below and behind the right rhinophore.

Discussion: Green colouration is not uncommon among *Elysia* spp. But the distinctive black margin of the parapodia, the black tips of the rhinophores and tail and the black medium stripe on the head separates *E. australis* from any other species. *E. australis* is further characterized by the large number (31) of teeth in the radula, their shape and lack of denticulations or serrulations.

E. australis is a new record for Queensland. It has previously been recorded from Coogee, south of Sydney (Angas, 1864:69), northwards to Angourie, Clarence River district (Allan, 1947:438). This record extends the range a further 100 miles northwards.

FAMILY HERMAEIDAE

Placida fralila sp. nov.

Text figs. 14-15.

Material: Greenmount, Coolangatta, 21-22 August, 1964, 4 specimens collected on the green alga *Codium* hanging from large boulders, Q.M. reg. no. MO2955 (holotype), Q.M. reg. no. MO2956. (1 paratype), N.M.V. reg. no. F25650 (2 paratypes).

Description: The living slugs (text fig. 14) were about 5 mm. in length, as preserved they are 2-3 mm. long. At first glance, the animal appears to be wholly dark green. In detail it is translucent yellowish with the dark green (identical with algal food habitat) liver branches and ducts shining through the integument. The cerata contain thick dark green branching liver ducts and thinner twisted yellowish albumen ducts. The preserved animals are pale green.

The body is rather slender. The head rounded in front and the short tail tapering behind. The foot is anteriorly rounded. The corners somewhat broader than the sole. Rhinophores cylindrical, auriculate, distally truncate. Cerata rather long, largest up to 2 mm. in length, set in eight oblique rows of 2-3 on each side. Microscopic examination of preserved cerata indicates that the liver duct has many small short branches each dilated and ramified at the end. The yellowish albumen ducts visible in the living slugs could not be traced in the preserved material.

The radula has 9 teeth in the ascending series and 20 or more in the descending spiral series. Each tooth (text fig. 15) has a slender cusp and very broad base; in profile, the cusp has a long point and the base is short.

A penial stylet was not determined.

Discussion: *Placida* Trinchese, 1876, differs from *Hermaea* Lovén, 1841, in having (i) ducts of the albumen gland as well as liver branches in the cerata, (ii) three genital apertures (triaulic) and (iii) a penial stylet (Pruvot-Fol, 1954:185-6). Species apparently correctly assigned to *Placida* are the type species *P. viridis* Trinchese, 1873 (Pruvot-Fol, 1954:187), *P. tardyi* Trinchese, 1876 (Pruvot-Fol, 1954-187), *Hermaea dendritica* (Alder and Hancock, 1843) (Pruvot-Fol, 1954-186), *Hermaea aoteana* Powell (1937:123), *Hermaea capensis* Macnae (1954:59) and *Hermaea dendritica* Baba (1955:10,41). The Japanese *H. dendritica* should be renamed as its radular teeth are not identical in shape with that of the European and west Atlantic species (vide Bergh, 1886, pl. 1, fig. 9-10; Vayssiere, 1888, pl. 6, fig. 95; Pruvot-Fol, 1954, fig. 71, *i*).

P. fralila appears to have fewer series of cerata than any of the above mentioned species, fewer radular teeth and these somewhat differently shaped. *P. aoteana* from New Zealand is in geographical terms the nearest species but has more slender attenuated teeth and many more cerata than the Australian species. There is also a larger pale green undetermined species of *Placida* occurring on the central Victorian coast (Burn, 1965: in press).

Placida is a new generic record for both Australia and Queensland. The species is named for the writer's grandparents, Frank and Lilian Lee, partly through whose generosity the trip to southern Queensland was made possible.

ORDER NOTASPIDEA
SUBORDER PLEUROBRANCHACEA
FAMILY PLEUROBRANCHAEIDAE

Pleurobranchaea maculata (Quoy and Gaimard).

Pleurobranchidium maculatus Quoy and Gaimard, 1832:301.
Pleurobranchaea novaezealandiae Cheeseman, 1878:276.
Pleurobranchaea dorsalis Allan, 1933:445.
Pleurobranchaea maculatus dorsalis. Allan, 1950:208.
Pleurobranchaea novaezealandiae. Burn, 1957:15.
Pleurobranchaea maculata. Burn, 1958:23.

Material: South end of Rainbow Bay, Coolangatta, September, 1964, 3 specimens collected from under stones in shallow tide pools. The specimens were not retained.

Discussion: *P. maculata* is a new record of genus and species for Queensland. The specimens were a dull reddish brown colour and little more than 25 mm. in length. Victorian and Tasmanian specimens are pale grey in colour and grow to 100 mm. in length.

ORDER NUDIBRANCHIA
SUBORDER DORIDACEA
SECTION EUDORIDACEA
TRIBE CRYPTOBRANCHIA
FAMILY DORIDIDAE

Rostanga arbuta (Angas).

Doris arbutus Angas, 1864:46, pl. 4, fig. 4.
Rostanga arbutus. Allan, 1947:445.
Rostanga arbutus. Allan, 1950:221.
Rostanga arbutus. Burn, 1957:18.

Material: Greenmount and Pt. Danger (Schnapper Rocks), Coolangatta, August, 1964, 3 specimens, crawling on rocks, Q.M. reg. no. MO2957.

Discussion: This is a new record of genus and species for Queensland. Though rather smaller than typical Sydney specimens, the present slugs conform in both shape and colour. The species is rather common at both abovementioned localities, crawling over the protected side of rocks and boulders in open positions.

SUBORDER EOLIDACEA

TRIBE CLEIOPROCTA

FAMILY FAVORINDAE

Austraeolis ornata (Angas).

Flabellina ornata Angas, 1864:67, pl. 6, fig. 7.
Flabellina ornata. Allan, 1950:224.
Austraeolis ornata. Burn, 1962:121.

Material: Greenmount, Coolangatta, August, 1964, 2 specimens crawling on rocks and boulders, Q.M. reg. no. MO2958.

Discussion: This species is already listed from Caloundra, Queensland (Kenny, 1960:224). It is the most common and among the largest eolids of eastern Australia. Details of the anatomy of *A. ornata* and the descriptions of two further species are to be published elsewhere. *A. fucia* Burn (1962:122) from Queenscliffe, Victoria, is probably a mutilated preserved specimen of *Facelina hartleyi* Burn (1962:116). A white body, dark red cerata and six rhinophoral lamellae are common to both species, but the radula and jaws of *F. hartleyi* have yet to be examined.

FAMILY AEOLIDIIDAE

Aeolidiella alba Risbec.

Aeolidiella alba Risbec, 1928:261, pl. 10, fig. 9.
Aeolidiella alba. Risbec, 1953:124.

Material: South end of Rainbow Bay, Coolangatta, September, 1964, 1 specimen found beneath a stone in shallow tide pool, Q.M. reg. no. MO2959.

Discussion: This is a new generic record for Queensland and specific record for Australia. The single specimen was yellowish white in colour and about 10 mm. in length, thus larger than the 6 mm. long unique type. Unfortunately the specimen was ingested by the carnivorous predator *Pleurobranchaea maculata* before any other notes could be made on the living animal. It was later retrieved from the gut of the *P. maculata* by dissection and is now somewhat mutilated.

A. alba is a distinctive species easily recognised by the two bulbous dilations of the cephalic tentacles, the two rhinophoral annulae and the white colouration with black speckling on the cerata. It has since been collected at Minnie Waters and Long Reef, New South Wales, and will be fully reported upon elsewhere. *A. japonica* Eliot, 1913 (Baba, 1949:111, 183, pl. 49, fig. 166) is a closely related species, the body colour of which is orange-brown. In Marcus' key to the Aeolidiidae (1961:56), *A. alba* and *A. japonica* come closest to *Spurilla* Bergh, 1864, whose species have perfoliate rhinophores and regularly graded smooth denticles on the radular teeth. Probably generic separation for these two species would be justified (Risbec, 1953) by detailed anatomical studies.

REFERENCES

ALLAN, J., 1932. A new genus and species of sea-slug, etc. *Rec. Aust. Mus.*, 18:314-320, pl. 34-35.

———, 1933. Opisthobranchs from Australia. *Ibid.*, 18:443-450, pl. 56.

———, 1947. Nudibranchia from the Clarence River Heads, etc. *Ibid.*, 21:433-463, pl. 41-43.

———, 1950. *Australian Shells.* 487 + 21 pp., 44 pl. Georgian House, Melbourne.

ANGAS, G., 1864. Description d'especes nouvelles . . . Mollusques Nudibranches . . . de Port-Jackson, etc. *J. Conchyliol.*, 12:43-70, pl. 4-6.

———, 1867. Description of thirty-two new species of marine shells from the coast of New South Wales. *Proc. Zool. Soc. Lond.*, 1867:110-117, pl. 13.

BABA, K., 1938. Opisthobranchia of Kii, Middle Japan, *J. Dept. Agric. Kyushu Univ.*, 6:1-19.

———, 1949. *Opisthobranchia of Sagami Bay.* 194 + 7 pp., 50 pl. Iwanami Shoten, Tokyo.

———, 1955. *Ibid.* Suppl. 59 pp., 20 pl. Iwanami Shoten, Tokyo.

BERGH, R., 1886. Beitrage zur Kenntniss der Aeolidiaden. VIII. *Verh. Zool.-Bot. Ges. Wien,* 35:1-60, pl. 1-7.

BURN, R., 1957. On some Opisthobranchia from Victoria. *J. Malac. Soc. Aust.*, 1:11-29.

———, 1958. Further Victorian Opisthobranchia. *Ibid.*, 2:20-36.

———, 1962. Descriptions of Victorian Nudibranchiate Mollusca, *etc. Mem. Nat. Mus. Melb.*, 25:95-128.

———, 1965. Opisthobranchia: Port Phillip Survey. *Ibid.*, in press.

CHEESEMAN, S. T., 1878. Description of three new species of opisthobranchiate Mollusca, etc. *Proc. Zool. Soc. Lond.*, 1878:275-277, pl. 15.

EALES, N., 1960. Revision of the world species of Aplysia, etc. *Bull. Brit. Mus. (Nat. Hist.)*, Zool. 5:267-404.

HABE, T., 1950. Hydatinidae, Bullidae and Akeridae in Japan. *Illust. Cat. of Jap. Shells* (ed. T. Kuroda), No. 3:17-24, pl. 3.

HEDLEY, C., 1910. Catalogue of the Marine Mollusca of Queensland, *Rep. Aust. Ass. Advanc. Sci.*, 12:343-372, 809-810.

———, 1923. Studies on Australian Mollusca. XIV. *Proc. Linn. Soc. N.S.W.*, 48:301-316, pl. 30-33.

IREDALE, T., 1929. Strange molluscs in Sydney Harbour. *Aust. Zool.*, 5:337-352, pl. 37-38.
Mus., 18:315-320, pl. 34-35.

———, 1937. Mollusca, Middleton and Elizabeth Reefs, etc. *Ibid.*, 8:232-261, pl. 15-17.

IREDALE, T., and D. F. McMICHAEL, 1962. A reference list of the marine Mollusca of New South Wales. *Mem. Aust. Mus.*, 11: 1-109.

KENNY, R., 1960. Some opisthobranch molluscs from Queensland. *Pap. Dept. Zool. Univ. Qd.*, 1:223-228.

KURODA, T., 1941. *Mem. Fac. Sci. Agric. Taihoku,* 22:133 (not seen).

MACNAE, W., 1954. On four sacoglossan molluscs new to South Africa. *Ann. Natal. Mus.*, 13:51-64, pl. 3.

MARCUS, E., 1957. On Opisthobranchia from Brazil (2). *J. Linn. Soc.* (Zool.) 43:390-486.

———, 1961. Opisthobranch mollusks from California. *Veliger,* 3(Suppl.):1-85, pl. 1-10.

MÖRCH, O., 1863. Contributions à la Faune malacologique des Antilles danoises. *J. Conchyliol.,* 11:21-43.

POWELL, A., 1937. New species of nudibranchiate Mollusca from Auckland waters. *Rec. Auckland (N.Z.) Inst.,* 2:120-124, pl. 30.

PRUVOT-FOL, A., 1954. Mollusques Opisthobranches. *Faune de France,* 58:1-448, pl. 1.

QUOY, J., and P. GAIMARD, 1832. *Voyage de découvertes de l'Astrolabe.* Zool. 2, 686 pp.; Atlas, 1833.

RANG, S., 1828. *Histoire naturelle des Aplysiens,* etc. 7 + 84 pp., 24 pl.

RISBEC, J., 1828. Contribution à l'étude des Nudibranches Néo-Calédoniens. *Faune Colon. Franc.,* 2:1-328, pl. A-D, 1-12.

———, 1953. Mollusques nudibranches de la Nouvelle-Calédonie. *Faune Un. Franc.,* 15:1-189.

SOWERBY, G., 1869. Monograph of the genus *Aplysia. Conch. Icon.,* 17: pl. 1-10.

VAYSSIÈRE, A., 1888. Recherches . . . Opisthobranches du Golfe de Marseille, etc. II. *Ann. Mus. Hist. Nat. Marseille,* Zool. 3, mem. 4:1-160, pl. 1-7.

WHITE, K., 1945. On two species of Aglaja from the Andaman Islands. *Proc. Malac. Soc. Lond.,* 26:91-102.

———, 1946. On a new species of Aglaja from Ceylon. *Ibid.,* 26:167-172.

EXPLANATION OF FIGURES

Bulla ovulum.
Fig. 1a-1b. Dorsal and ventral views of Coolangatta shell.
Fig. 2a-2b. Ditto of ex pisces shell.
Fig. 3. Radula.
Fig. 4. Penis.

Bulla orientalis.
Fig. 5. Dorsal view of shell.
Fig. 6. Ventral view of shell.
Fig. 7. Radula.
Fig. 8. Penis.

Doridium taronga.
Fig. 9. Dorsal view of living slug.
Fig. 10. Penis.

Chelidonura conformata.
Fig. 11. Dorsal view of living slug.
Fig. 12. Penis.

Elysia australis.
Fig. 13. Radular tooth.

Placida fralila.
Fig. 14. Dorsal view of living slug.
Fig. 15. Radular tooth.

Abbreviations: *a*—rachidian; *b*—penis; *c*—prostate gland or prostatic duct; *d*—penial atrium; *e*—ciliated furrow; *f*—coils of penis; *g*—duct from penial coils; *h*—seminal furrow; *i*—seminal vesicle.

INSTRUCTIONS TO AUTHORS

1. It is the responsibility of authors to prepare papers in a form suitable for publication, and they should consult a current issue in order to familiarize themselves with the practices of the *Journal,* with particular reference to the use of bold-face or italic type, headings, etc.
2. No paper shall be published unless approved by the Editor and the Committee and any paper may be submitted to one or more referees before acceptance.

3. Upon acceptance for publication, the paper, including plates, maps, diagrams and all copyrights thereof become the property of the Society.
4. Papers should be double-spaced type-script on one side of the paper only with 1½" margins. The author's name should appear underneath the title with a footnote indicating the address of the institution (if any) to which he belongs and any necessary acknowledgements. A summary of longer papers should be included. The original type-script and one carbon copy should be submitted.
5. As a standard of spelling, the *Journal* uses the *Concise Oxford Dictionary of Current English* (1951, 4th ed., Clarendon Press, Oxford).
6. References should be cited in the text by year of publication, e.g., Leloup (1961) or, if there are several publications by the same author in the same year, Leloup (1961a, 1961b) and they should be arranged at the end of the article in alphabetical order of the authors' names in the following form:

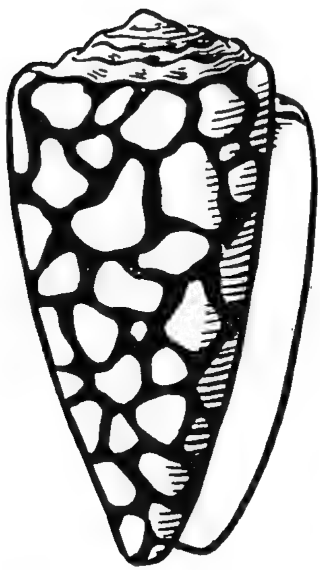
   Leloup, E., 1961. Species of the Genus *Liolophura* Pilsbry, 1893 (Mollusca, Polyplacophora). *J. Malac. Soc. Aust.*, 5:39-49, pl. 3, text figs. 1-5.

   References to books should give the year of publication, the number of the edition, the name of the publisher and the city of publication. Abbreviations of periodicals should conform with those used in *A World List of Scientific Periodicals* (1952, 3rd ed., Butterworth, London), except that capital initial letters are used throughout, thus "*J. Malac. Soc. Aust.*".
7. Symbols and abbreviations should conform with those recommended in the Royal Society's publication, *General Notes on the Preparation of Scientific Papers* (1950, Cambridge University Press, London), e.g., all names which are to be printed in italics (such as generic and specific names) must be underlined in the type-scripts.
8. When possible, a proof will be supplied to the author for correction. In general corrections should not include changes from the original text. Such changes may be charged to the author if the Editor deems them to be excessive.
9. A reasonable number of text figures and plates will be reproduced at no cost to the author. Reproduction of special art paper or in colour must, as a rule, be paid for by the author. Full plate size is 6½" by 4" and the maximum width for text figures is 4".
10. Tables should carry a short heading describing the nature of the facts assembled. Both figures and plates, as well as graphs and tables, should be fully comprehensible without reference to the text if possible.
11. New taxonomic units of any kind shall be published only if the description is clearly set out and conforms with the requirements of the *International Code of Zoological Nomenclature* (1961, International Trust for Zoological Nomenclature, London) as amended.
12. Descriptions of new species or subspecies should not be submitted unless arrangements have been made by the author for depositing the holotype with a recognised public Museum, and Museum numbers of the type specimens should be included in the paper. Type localities should be defined as accurately as possible.
13. The Editor reserves the right to make literary amendments, but authors will see any such amendments before publication.
14. Reprints are obtainable by previous arrangement with the Editor. Twenty-five copies are provided free and additional copies will be charged to authors.

JOURNAL OF THE

MALACOLOGICAL SOCIETY OF AUSTRALIA

No. 10



Published 16th November, 1966

THE MALACOLOGICAL SOCIETY OF AUSTRALIA

1966

Printed by SURREY BEATTY & SONS, Rickard Road, Chipping Norton, N.S.W. Registered in Australia for Transmission by Post as a Book.

Published annually by the Malacological Society of Australia and obtainable from the Hon. Editor, C/o The Australian Museum, College Street, Sydney, N.S.W. Price $2.00 Australian, or $2.25 U.S. Currency, or 16/- Sterling. Special rates for complete sets.

NEW SPECIES OF MOLLUSCA FROM EASTERN AUSTRALIA (PART 2) WITH NOTES ON SOME KNOWN SPECIES

By T. A. GARRARD*

Pl. 1

Since I last wrote under the above heading (1963, *J. Malac. Soc. Aust.*, 7: 42-46) additional new species have been discovered by trawling in the deeper waters of southern Queensland, mainly in the one area due east of Caloundra, while many more known species thought previously to have been indigenous only to Japan and/or the Philippine Islands have also been found. Several new species have been forwarded to other workers specialising in certain families for description and naming, while nine others are recorded and described here. A list of new records of known species for the east coast of Australia is in course of compilation and will be published at a later date.

CLASS BIVALVIA

FAMILY SPONDYLIDAE

SPONDYLUS Linné 1758, *Syst. Nat.*, 10 ed., p. 690. Type species by subsequent designation (Anton, 1839, *Verz. Conch.*, p. 19) *gaederopus* Linné.

Spondylus tenuitas sp. nov.

Pl. 1, fig. 3.

Remarks: This very attractive new addition to the genus appears only to have been taken so far from about 80 fathoms 18 miles N.N.E. of Cape Moreton, Queensland, although deep water trawling in other areas may well extend its range. The short spines suggest a shore or reef dwelling form rather than a deep water species, and being a mud dweller the lower valve is not attached. The only other Australian species of similar form and sculpture appears to be the Victorian Miocene fossil, *Spondylus pseudoradula* McCoy.

Description: Shell almost equivalve, equilateral in early stages, tending to be somewhat produced posteriorly at maturity. Shell a mud-dweller, non-adherent, but position in life unknown. Lower or right valve with six rows of thin major spines, rounded on top and channeled below, with three to five rows of almost vertical prickles between each major row; several additional spines on each edge of valve near dorsal margin. Upper or left valve similarly sculptured but spines less prominent in major rows, lacking altogether near ventral margin, and 12 to 16 rows of almost vertical prickles between each major row, varying somewhat in size. Triangular ligamental area on right valve narrow and very finely grooved axially, with short similar grooves inside edge of left valve; hinge teeth somewhat small; interior margins crenulate; posterior muscle scar roughly circular. Shell white inside and out, occasionally with a light brown flush near umbonal area and sometimes on tips of prickles.

* Honorary Associate, The Australian Museum, Sydney.

Dimensions: Holotype, length 54 mm., breadth 45 mm., height of conjoined valves 22 mm.

Type locality: Trawled in 80 fathoms, 18 miles N.N.E.. of Cape Moreton, due east of Caloundra, Queensland.

Types: Holotype presented to Australian Museum Sydney, where it is registered No. C. 64802, together with four single valves.

FAMILY CARDIIDAE

VASTICARDIUM Iredale, 1927, *Rec. Aust. Mus.,* 16: 76. Type species by original designation *nebulosa* Martyn.

Vasticardium nigropunctatum Habe and Kosuge.

Pl. 1 figs. 9a, 9b.

An illustration of this species appears on Plate 1 as it was to have been described as new; however it has since been described and named as above by Habe and Kosuge from the Amami Islands, south of Kyushu, Japan (*Venus* 24: 340, pl. 29, fig. 16, May 1966).

The specimen figured here is from North Keppel Island, Queensland, and further specimens are in Australian Museum collection from Port Curtis and North Barnard Is., both Queensland, also Vanikoro and Bali, so that the Amami Islands, now the type locality, greatly extends the range of the species. The shell bears a resemblance to both *V. dupuchense* (Reeve) and *V. mindanense* (Reeve) but lacks the red interior of these two species, being pure white inside, and is distinguished exteriorly by black spots on the posterior ribs arranged roughly in concentric rows.

CLASS GASTROPODA

FAMILY CERITHIOPSIDAE

NOTOSEILA Finlay, 1927, *Trans. Proc. N.Z. Inst.,* 57: 383. Type species by monotypy *terebelloides* Hutton.

Notoseila magna Laseron

Notoseila magna Laseron, 1951, *Aust. Zool.,* 11: 365, pl. 37, fig. 35.

Remarks: The protoconch of this species was not available to Laseron for description, and as a number of live taken specimens have been in my possession for some time, trawled in 35 fathoms off Gabo Is., Victoria, opportunity is taken to place a description on record, three protoconchs being in perfect condition. Laseron described as follows the protoconch of what he took to be the allied species *Seila crocea* Angas from 35 fathoms off Bateman's Bay, New South Wales:

"Protoconch sharply pointed, in the line of the spire, of three whorls, plus an infolded nucleus, rather paler than the mature shell, smooth and glassy, sculpture appearing suddenly on the first mature whorl with no apparent varix."

This description also fits perfectly the protoconch of *magna,* indicating the close relationship of the two species, although *crocea* grows to about 7 mm. in length, while the largest *magna* studied reaches 21.5 mm. Several specimens have been presented to the Australian Museum Sydney.

FAMILY OLIVIDAE

ZEMIRA H. & A. Adams, 1853, *Gen. Rec. Moll.*, p. 110. Type species by monotypy *australis* Sowerby.

*Zemira bodalla** sp. nov.

Pl. 1 fig. 8

Remarks: Although very similar in most respects to the type species of *Zemira,* this species differs on sight by its larger size and decidedly coarser sculpture; the salmon-pink mouth colour is replaced by pure white, and the operculum is coarser and heavier. Although the shells of this genus bear little resemblance to the genus *Oliva* Bruguière, they have been included in the Family Olividae following the classification of Wenz (1938, *Handb. der Paläozool.* (Schindewolf) 6, 1:1267).

Description: Shell of four whorls, protoconch of one whorl, smooth and dome like, merging gradually into sculpture of main whorls, which commences with five or six spiral striations over-ridden with fine growth striae, which later become coarser and somewhat eroded in appearance, giving a cancellate effect; on body whorl below the shoulder are 10 to 15 spiral striae, one or two towards the top frequently wider than the others, until one very deep striation is encountered, ending in a sharp spur on outer lip, ridges or cords between striations being flat topped; below the deep striation occur about seven more-rounded ridges each bisected by a further striation; all striae are punctate; area between suture and shoulder deeply canaliculate and crossed by sinuate growth striae; aperture oval, columella curved and callused, a small anterior canal present, a clearly defined sinus at posterior end, and outer lip crenulate on either side of spur. Colour white, heavily blotched with dark brown, which occasionally encroaches into canaliculate shoulder area, mouth white. Periostracum light brown and extremely thin when present. Operculum horny, fairly heavy, with concentric growth striae and terminal nucleus; no radiating lines as in operculum of *australis.*

Dimensions: Holotype, length 27 mm., breadth 17.5 mm., length of aperture from shoulder to end of canal 17.5 mm.

Type locality: Trawled in 80 fathoms, 18 miles N.N.E. of Cape Moreton, due east of Caloundra, Queensland.

Types: Holotype presented to Australian Museum, Sydney, where it is registered No. C. 64798, together with one paratype.

FAMILY VOLUTIDAE

MICROVOLUTA Angas, 1877, *Proc. Zool. Soc. Lond.*, 1877: 34. Type species by monotypy *australis* Angas.

Microvoluta royana Iredale

Microvoluta royana Iredale, 1924, *Proc. Linn. Soc. N.S.W.*, 49: 269, pl. 35, fig. 13.

Remarks: A careful comparison of the holotype of this species with that of *Vicimitra jervisensis* Laseron, 1951 (*Rec. Aust. Mus.*, 22, p. 341, fig. 4) shows the two species to be identical in all respects, with the

* An aboriginal word meaning "several waters."

sole exception that *royana* has ill defined axial ribs, while in *jervisensis* the transverse sculpture consists only of fine growth lines. However a series of specimens from off Twofold Bay, Bateman's Bay and Port Hacking, all in N.S.W., shows the slight ribbing to be a variable feature, and definitely links the two species. *Vicimitra jervisensis* Laseron must therefore be regarded as a synonym of *Microvoluta royana* Iredale.

FAMILY MARGINELLIDAE

VOLVARINELLA Habe, 1951, *Illus. Cat. Japanese Shells*, p. 101, fig. 10. Type species by original designation *makiyamai* Habe.

Volvarinella dimidia sp. nov.

Pl. 1 fig. 2.

Remarks: Although only one specimen of this new species has so far come to hand, it is live taken, in perfect condition, and so distinct in appearance that it cannot be confused with any others of the genus, especially with the unusual combination of protoconch and teleoconch each consisting of 2½ whorls. The shell differs from the closest known species, *Volvarinella makiyamai* Habe, in having a consistently narrow aperture, not expanding towards anterior end, also the flat sided whorls and prominent shoulders; it differs from *Volvarinella teramachii* Habe by having one tooth only on outer lip instead of several, again the flat sided whorls and prominent shoulders, and a different colour pattern.

Description: Shell small, elongate, semi-translucent, highly polished and devoid of sculpture, whorls somewhat flat with prominent shoulders; protoconch of 2½ whorls, translucent and terminating abruptly before commencement of main whorls, which also number 2½; sutures a little impressed; aperture straight and somewhat narrow; four strong plaits occupy two-thirds of anterior end of columella, upper pair transverse, anterior pair oblique; outer lip heavily callused and reflected, with one fairly prominent tooth at posterior end. Colour translucent white, one narrow fawn band on body whorl a little below suture, one broad fawn band round periphery, a short orange band round anterior end, two narrow brown bands round other whorls.

Dimensions: Holotype, length 6.8 mm., breadth 3.1 mm., length of aperture 3.2 mm.

Type locality: Trawled in 65 fathoms, 18 miles N.N.E. of Cape Moreton, due east of Caloundra, Queensland.

Types: Holotype, the only known specimen, presented to the Australian Museum, Sydney, where it is registered No. C. 64805.

FAMILY FASCIOLARIIDAE

LATIRUS Montfort, 1810, *Conch. Syst.*, 2: 530, 531. Type species by original designation *gibbulus* Gmelin.

Latirus strangei A. Adams

Latirus strangei A. Adams, 1854, *Proc. Zool. Soc. Lond.*, 1854: 316; Watson, 1886, *Rep. Sci. Res. Challenger, Zool.*, 15: 245, pl. 14, fig. 4.

Remarks: This species was described by A. Adams from Sydney, New South Wales, a fairly adequate description being given but no

illustration. The species was later recorded by Watson from Levuka, Fiji, in 12 fathoms, and an excellent illustration given. For some reason this species was disallowed by Hedley, 1917, in his Check-list of the Marine Fauna of New South Wales, p. 85, but a live-taken specimen recently forwarded to me for identification from 60 fathoms off Broken Bay, New South Wales, leaves no doubt as to its identity, and the species can now be restored to the N.S.W. list.

Latirus staminatus sp. nov.

Pl. 1 fig. 6.

Remarks: This fine species is very small for the genus, and somewhat resembles *Latirus pulchellus* Philippi (*Fusus*) from the Mediterranean, but has a longer anterior canal, and all main spiral ridges are of equal prominence, besides other minor differences. It can be readily recognised by the brilliantly polished protoconch and the raised spiral ridges like white cotton threaded regularly round the whorls.

Description: Protoconch of 1½ whorls, smooth and brilliantly polished, deep brown initially, fading to lighter brown, developing about four axial plications before terminating abruptly at commencement of main whorls, which number five; 12 axial plications to each whorl, crossed by prominent spiral ridges showing only on axial plications, five on body whorl, four on penultimate and three on others, with a finer thread between each; in addition, two somewhat undulating ridges below the sutures; smaller ridges and threads continue anteriorly, becoming very oblique towards end of shell. Aperture a little more than half total length, columella curved, no callus, a small ridge at posterior end forms an indefinite canal, anterior canal straight and open, usual small ridges at anterior end of columella barely discernible; outer lip thin and simple, several pronounced internal spiral ridges commence a little behind outer lip. Colour light brown, a dark brown band below sutures and round centre of body whorl, dark patches at anterior end, aperture white tinted with pale blue, spiral ridges white on axial ribs. Operculum is vestigial, less than 2 mm. in length, light brown, horny, with fine concentric ridges, nucleus at right hand side.

Dimensions: Holotype, length 15 mm., breadth 6 mm., length of aperture 9 mm.

Type locality: Trawled in 68 fathoms, 18 miles N.N.E. of Cape Moreton, due east of Caloundra, Queensland.

Types: Holotype, one of three specimens found, presented to the Australian Museum, Sydney, where it is registered No. C. 64804.

FAMILY FUSINIDAE

GRANULIFUSUS Kuroda and Habe, 1954, *Venus* (*Kyoto*), 18: 89. Type species by monotypy *niponicus* Smith. (Under Article 13 of the International Code, the above genus is unavailable as of Kuroda and Habe, 1952, *Check List & Bibliog. Rec. Mar. Moll. Japan,* p. 59, but as a generic description was later given in *Venus* in November 1954, the genus is available as of that date).

Granulifusus consimilis sp. nov.

Pl. 1 fig. 7

Remarks: This interesting small species, which has recently been brought up in quantity in prawn nets from 70-100 fathoms N.N.E. of Cape Moreton, Queensland, due east of Caloundra, has a somewhat similar appearance to *Pseudolatirus kurodai* Okutani and Sakurai and to

P. pallidus Kuroda and Habe from Japanese waters, and is midway between these two species in size. However the position of the operculum nucleus places it in the genus *Granulifusus*, and a specimen shell sent to Dr. T. Habe for examination shows it to disagree with any named Japanese species.

Description: Shell rather small for the family, elongately fusiform, with long slightly recurved siphonal canal, aperture and canal being a little more than half total length of shell, outer lip thin and simple. Protoconch at 45° angle to main whorls, straw coloured, translucent and shining, of 1½ whorls and merging gradually into sculpture of main whorls, which number seven; whorls rounded, sutures impressed. Sculpture consists of about ten pronounced axial ribs to each whorl, over-ridden by numerous spiral cords, four major cords to each whorl, a less pronounced cord between each, and still smaller cords between these, whilst others extend at an oblique angle on body whorl below periphery to base of shell; initial three whorls present a beaded appearance. Colour fawn with axial bands of brown between ribs, all primary cords and main secondary cords yellowish on ribs and deep brown between; aperture varies from pure white to light blue. Periostracum when present thin and straw coloured. Operculum light brown, glossy, pear shaped, fairly heavily concentrically ridged, with nucleus at lower right hand side.

Dimensions: Holotype, length 32.5 mm., breadth 12.5 mm., length of aperture 19.5 mm. Largest paratype, length 41.5 mm., breadth 15.5 mm., length of aperture 25.5 mm.

Type locality: Trawled in 70-100 fathoms, 18 miles N.N.E. of Cape Moreton, due east of Caloundra, Queensland.

Types: Holotype presented to the Australian Museum, Sydney, where it is registered No. C. 64795, together with several paratypes.

PLATE 1.

Fig. 1. *Cleobula albonerosa* sp. nov., Mag. x 0.5. Holotype. Aust. Mus. No. C. 64807. Deep water off Wide Bay, southern Queensland.

Fig. 2. *Volvarinella dimidia* sp. nov., Mag. x 5. Holotype. Aust. Mus. No. C. 64805. Deep water east of Caloundra, southern Queensland.

Fig. 3. *Spondylus tenuitas* sp. nov., Mag. x 0.7. Holotype. Aust. Mus No. C. 64802. Deep water east of Caloundra, southern Queensland.

Fig. 4. *Leptoconus recluzianus* Bernardi Mag. x 0.65. Trawled in 65-75 fms., east of Caloundra, southern Queensland. L. Field Collection.

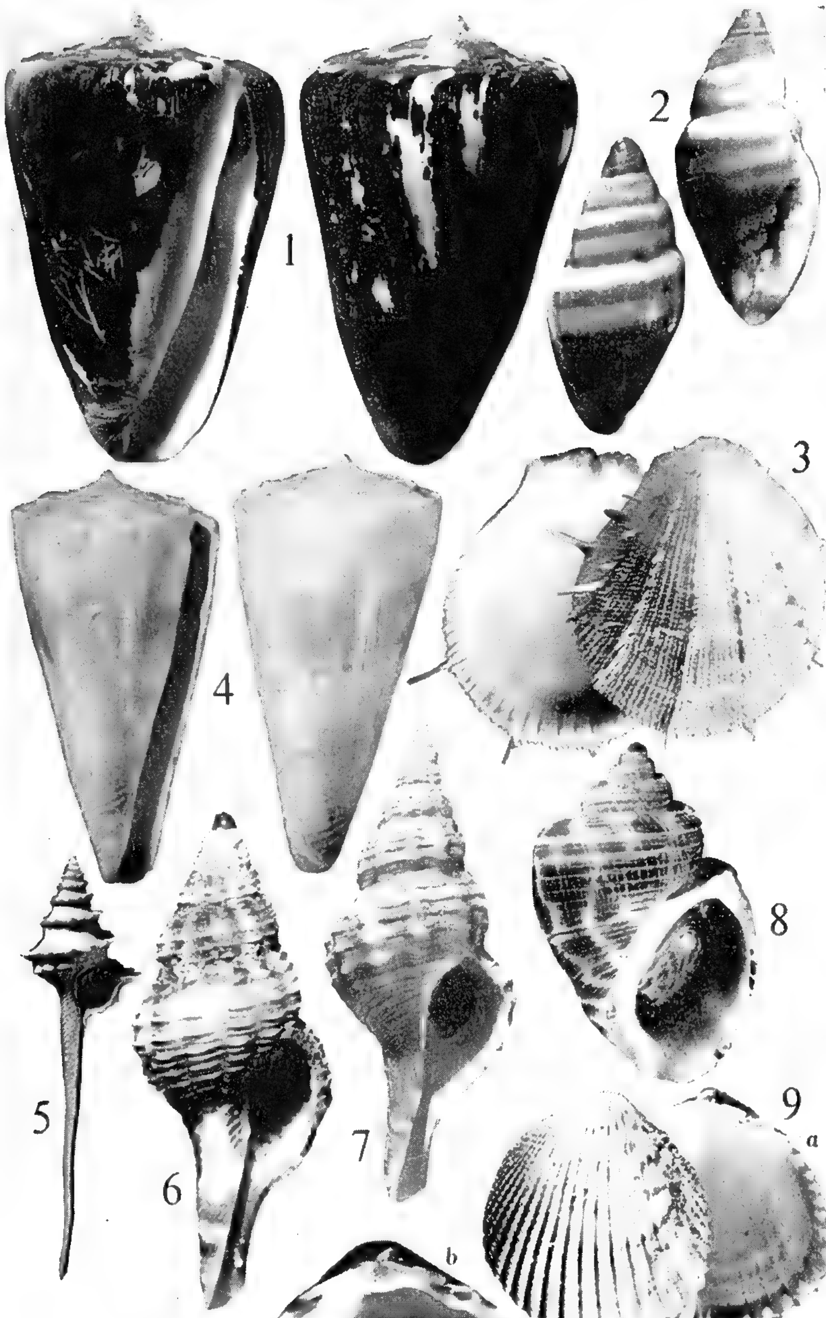
Fig. 5. *Columbarium caragarang* sp. nov., Mag. x 0.7. Holotype. Aust. Mus. No. C. 64800. Deep water east of Caloundra, southern Queensland.

Fig. 6. *Latirus staminatus* sp. nov., Mag. x 4. Holotype. Aust. Mus. No. C. 64804. Deep water east of Caloundra, southern Queensland.

Fig. 7. *Granulifusus consimilis* sp. nov., Mag. x 1.8. Holotype. Aust. Mus. No. C. 64795. Deep water east of Caloundra, southern Queensland.

Fig. 8. *Zemira bodalla* sp. nov., Mag. x 1.5. Holotype. Aust. Mus. No. C. 64798. Deep water east of Caloundra, southern Queensland.

Fig. 9. *Vasticardium nigropunctatum* Habe and Kosuge. Mag. x 0.7. Aust. Mus. No. C. 64797. North Keppel Island, Queensland.


1
2
3
4
5
6
7
8
9
a
b

FAMILY MURICIDAE

HAUSTELLUM Schumacher, 1817, *Essai. nouv. Syst. Test.*, pp. 64, 213. Type species by tautonymy *haustellum* Linné.

Haustellum tweedianum (Macpherson)

Murex tweedianus Macpherson, 1962, *Mem. Nat. Mus., Melb.*, 25: 176, new name for *Murex espinosus* Macpherson, 1959, *Mem. Nat. Mus., Melb.*, 24: 51, pl. on p. 56, figs. 1, 1a, not *Murex espinosus* Hutton, 1886.

Remarks: Two interesting albino specimens of this species have come under notice from 60-70 fathoms due east of Caloundra, Queensland, the normal pink and fawn background colour being replaced by a translucent off-white, and the only remaining colour being faint yellow markings on the spiral ridges.

FAMILY COLUMBARIIDAE

COLUMBARIUM Martens, 1881, *Conch. Mittheil.*, 2: 105. Type species by monotypy *spinicinctum* Martens.

*Columbarium caragarang** sp. nov.

Pl. 1 fig. 5

Remarks: This species strangely enough is found in deep water in much the same locality as *Columbarium spinicinctum* Martens, but differs on sight by having 25 or more rows of very fine hollow scales down the back of anterior canal, compared with three to six rows of longer spiny scales of *spinicinctum*, whilst peripheral spines are shorter and more numerous on the body whorl. It has been suggested that this species is *C. pagodoides* Watson, which amongst other localities was supposed to have been taken from the disputed "Challenger" station in 410 fathoms off Sydney. However a comparison with the syntypes of *C. pagodoides* in the British Museum (Natural History), through the courtesy of Mr. Norman Tebble, shows that it is altogether different, the main points for comparison being the upturned minute hollow scales on the peripheral keel of *pagodoides* in lieu of spines, one keel in lieu of two on the body whorl below the periphery, protoconch twice as large as this new species, the small raised scales on back of anterior canal intermediate in size between this new species and *spinicincta* and an intermediate number of rows. The differences between this new species and *spinicincta* could possibly be due to sexual dimorphism, but a long series of live taken specimens of both species would be necessary for examination of the animal to determine this point.

Description: Shell is a typical *Columbarium* in general shape, long spired and with extremely long anterior canal; whorls seven, a prominent but small mamillate protoconch of two whorls, smooth and translucent; sutures impressed, top of whorls sloping sharply outwards to periphery and sculptured with numerous close packed and prominent growth striae; hollow peripheral spines numbering 15 on body whorl and penultimate whorl, slowly increasing in size; sculpture below periphery of similar growth striae to that above, followed on body whorl by two prominent rows of close packed overlapping scales, then many close set rows of extremely fine scales down three-quarters of length of anterior canal, which is fairly straight and almost closed; aperture somewhat triangular,

---

* An aboriginal word meaning "the sea."

columella curved, with well defined callus across inner lip; whole shell a pale horn colour varying to off-white, with faint spots and splashes of chestnut both above and below periphery; aperture off-white. Unfortunately operculum is damaged, but is broadly pear shaped, horn coloured, with overlying grey epidermis, fine concentric growth marks, and apparently a terminal nucleus.

Dimensions: Holotype, length 75 mm., breadth 22.5 mm., length of aperture 7.5 mm. Size of largest paratype, length 93 mm., breadth 24 mm., length of aperture 8 mm.

Type locality: Trawled in 70-85 fathoms, 18 miles N.N.E. of Cape Moreton, due east of Caloundra, Queensland.

Types: Holotype presented to Australian Museum, Sydney, where it is registered No. C. 64800, together with several paratypes.

FAMILY CONIDAE

LEPTOCONUS Swainson, 1840, *Treat. Malac.*, p. 312. Type species by subsequent designation (Herrmannsen, 1847, *Ind. Gen. Malac.*, 1: 584) *amadis* Martini (= *amadis* Gmelin).

Leptoconus recluzianus (Bernardi)

Pl. 1, fig. 4.

Conus recluzianus Bernardi, 1853, *J. Conchyliol.*, 4: 148, pl. 6, fig. 6.

Remarks: This species was included in Plate 1 which was made some time prior to publication, as it appeared at the time to be a new species. However subsequent research has shown it to be *L. recluzianus* (Bernardi) described originally from "China Seas." The species is thus a further new record for the Queensland coast, several specimens having been trawled in 60-75 fms., 18 miles N.N.E. of Cape Moreton, due east of Caloundra.

The specimen illustrated measures 79 mm. in length and 38.5 mm. in breadth and was kindly loaned by Mr. L. Field of Southport, Queensland. The largest specimen so far examined by me measured 93.5 mm. in length and 41 mm. in breadth.
CLEOBULA Iredale, 1930, *Mem. Qd. Mus.*, 10: 78. Type species by original designation *figulinus* Linné.

Cleobula albonerosa sp. nov.

Pl. 1 fig. 1

Remarks: This large heavy cone shell first came to my notice about 1943 and has been well known to most collectors on the eastern coast of Australia for many years, and it is strange that it has not been described and named previously. It was illustrated as *Cleobula* sp. by Marsh and Rippingale, (1965, *Cone Shells of the World*, pl. 15, fig. 17) and mention is made (on p. 112) that the species bears a superficial likeness to *C. quercinus* Solander. In general outline it also strongly resembles *C. fergusoni* Sowerby from Central America.

Description: Shell large and very heavy, of about 11 whorls, protoconch worn smooth, spire flatly concave, heavy rounded shoulders, sides concave medially, anterior end with a heavy reflected callus, mouth wide and broadened anteriorly, outer lip thick but fairly sharp, restricted medially; a broad heavy ridge encircles the interior of shell, following the central

concave exterior; sculpture of irregular growth striae, with irregular revolving poorly developed ridges towards anterior end, fading as maturity is reached; spire with numerous fine revolving striations, sutures overlapping shoulder of previous whorl, becoming more irregular with age. Colour whitish to deep cream in irregular patches, interior white. Periostracum deep brown, coarse and heavy, with a satin sheen.

Dimensions: Holotype, length 110 mm., breadth 62 mm., length of aperture 98 mm.

Type locality: Trawled in 35 fathoms off Wide Bay, southern Queensland.

Types: Holotype presented to the Australian Museum, Sydney, where it is registered No. C. 64807. One paratype in my possession.

ILLUSTRATIONS OF UNFIGURED NEW SOUTH WALES MARINE MOLLUSCS, PART 1.

By DONALD F. McMICHAEL* and JACQUES VOORWINDE†

Pls. 2, 3.

During the period 1918 to 1962, a great deal has been published concerning the nomenclature of the marine molluscs of New South Wales. The dates are significant in that they represent the time of publication of the two check-lists of New South Wales marine molluscs, those of Hedley, and Iredale and McMichael respectively. The latter incorporated the nomenclatural changes which had been made, principally by Iredale and Laseron, during the intervening years and was intended to provide a rapid source of reference to the extensive literature. In each case, the original reference to the introduction of a new nominal species was cited together with original figures, if any. In some cases, when no figure accompanied the introduction of a name, another reference to an illustration of that species was cited. However a few nominal species remained without reference to any figure, and since these are mostly Iredalean species, which were often described in only a few lines, or even words, and with only the vaguest of comparative data, the recognition of the taxa concerned is difficult.

When the Reference List (Iredale and McMichael, 1962) was published, it was intended to include all the nomenclatural changes which had been made to that time, if considered acceptable by the senior author. The work of some authors was ignored (e.g. Laursen, 1953) or treated with scepticism (e.g. Fleming, 1957). The present paper makes no attempt to overcome these deficiencies. It is concerned only with the fact that among the many nominal species listed for New South Wales, some have never been figured. One of us (J.V.) has listed the species which remain unfigured at this date and it is intended to provide illustrations in a series of papers of the type specimens, so that local workers may be helped with the identification of these forms, and revisers may have a better idea of the taxa represented by the names listed. Nomenclatural comments on the validity of the names, and some additional descriptions (by J.V.) and taxonomic comments on the species are given, but the latter should not be taken as the final word. In the following descriptions, the emphasis is laid on the clear-cut differences which can be recognised in the type material. However, when the larger number of specimens now available is studied, in many cases the differences tend to diminish, suggesting that specific differentiation may not be justified. There is obviously a great need for thorough revision of many of the groups involved, but it is left to others to undertake such work.

* Curator of Molluscs, The Australian Museum, Sydney.

† Honorary Associate, The Australian Museum, Sydney.

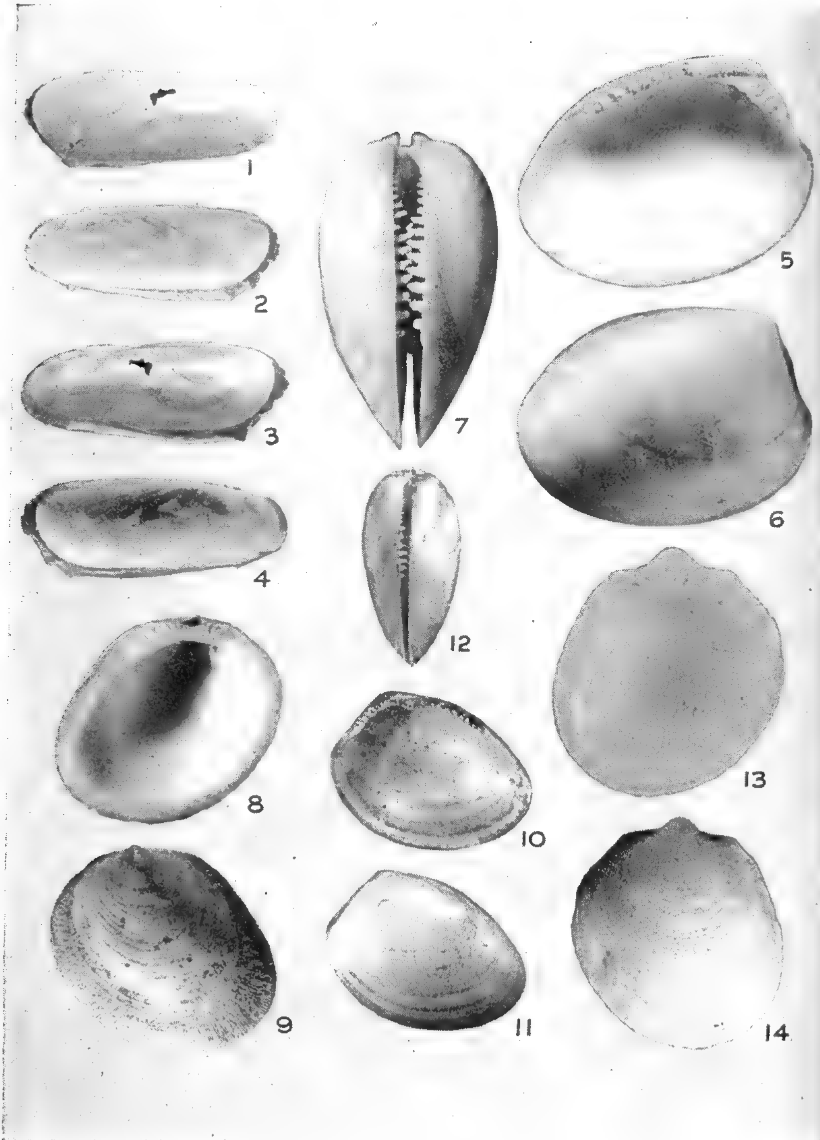


PLATE 2

Figs. 1-4. *Solemyarina velesiana* Iredale. Holotype, A.M. No. C. 7476.
Figs. 5-7. *Ennucula duritas* Iredale. Lectotype, A.M. No. C. 47082.
Figs. 8, 9. *Versipella soboles* Iredale. Holotype, A.M. No. C. 24366.
Figs. 10-12. *Ennucula astricta* Iredale. Lectotype, A.M. No. C. 47083.
Figs. 13, 14. *Aspalima solator* Iredale. Lectotype, A.M. No. C. 19794.

PHYLUM MOLLUSCA

CLASS BIVALVIA

Solemyarina velesiana Iredale

Pl. 2, figs. 1-4.

Solemyarina velesiana Iredale, 1931, *Rec. Aust. Mus.*, 18: 201. Reference List No. 1.

Remarks: This name was introduced with a brief description and comparison with the Queensland species, *S. terraereginae* Iredale, with which it does not appear to be conspecific. It is however not a nomen nudum as interpreted by us (see McMichael, 1964). The validity of the genus *Solemyarina* has been questioned by Macpherson and Gabriel (1962) as it was introduced because of uncertainty as to the type species of *Solemya* Lamarck. The latter has now been established as *S. australis*, and it thus seems likely that *Solemyarina* should be regarded as a subjective synonym of *Solemya*. Although Iredale did not designate a holotype in the original publication, there is only a single specimen from the type locality (Sydney) in the Australian Museum collection, which is therefore regarded as the holotype, No. C. 7476. This measures 9.5 mm. in length and 4 mm. in height.

Description: Shell small, equivalve, very inequilateral, colour off-white, periostracum nearly smooth, colourless and continuous beyond the margin and not interrupted by slits opposite the ribs as in *Solemya australis* (from South Australia) and *S. terraereginae;* both ends rounded; dorsal and ventral margins not parallel as in *australis* and *terraereginae*, but ventral margin expanded posteriorly; sculpture not ribbed but with very faint close set ill-defined striations over the whole surface of the shell; hinge as in *Solemya;* interior off-white.

Ennucula duritas Iredale

Pl. 2, figs. 5-7.

Ennucula duritas Iredale, 1931, *Rec. Aust. Mus.*, 18: 202. Reference List No. 3.

Remarks: This species was described with a brief diagnosis and comparison with the southern *Ennucula obliqua* (Lamarck); the type locality was "the Harbour" i.e. Sydney Harbour. A series of syntypes from Goat Island, Sydney Harbour, collected by John Brazier, No. C. 47082, are in the Australian Museum, with Iredale's manuscript label "*Ennucula duritas* Type" attached. The lectotype here selected and illustrated is the largest of this series, measuring 22 mm. in length and 9.5 mm. in height. Comparison of this type series with many *Ennucula* from off Sydney suggests that the taxon is not really distinct from *E. obliqua;* indeed all the New South Wales nominal species of *Ennucula* may represent variant populations of the one species. We have been unable to recognise any specimens which agree with the description of *Ennucula consobrina* (A. Adams and Angas) or with the figure given by Hedley (1913). Dell (1956) regards *Ennucula* as a valid genus but Macpherson and Gabriel (1962) following Thiele (1934) place it in the synonymy of *Leionucula* Quenstedt.

Description: Thin, small, elongate, more inequilateral and smaller than typical *obliqua;* umbos very blunt but well defined; periostracum light brown: anterior teeth 5, posterior teeth 22. The species is found in Sydney Harbour from the Heads to the mouth of the Lane Cove River.

Ennucula astricta Iredale

Pl. 2, figs. 10-12.

Ennucula astricta Iredale, 1931, *Rec. Aust. Mus.,* 18: 202. Reference List No. 5.

Remarks: There is some confusion over the exact form of introduction of this name. In the Reference List, Iredale and McMichael indicate that it was introduced as a new name for *Nucula simplex* A. Adams, non *N. simplex* Deshayes, and a figure of the type of *N. simplex* A. Adams, published by Hedley (1913) was cited. Reference to Iredale (1931) indicates that this is not correct. The name is introduced as a "sp. nov." not a "nom. nov." for "the local shell," specimens from Port Stephens recorded by Hedley as "*antipodum* Hanley" being mentioned. These specimens are in the Australian Museum, No. C. 47083, from the Old Collection, and are labelled "*astricta* Ired. Type" in Iredale's hand. Comparison with Hedley's figure of the type of *simplex* A. Adams shows that the Port Stephens shells do not agree exactly, consequently we illustrate the lectotype of *astricta* Iredale, which is the larger of the two syntypes. It measures 10.5 mm. maximum length, by 8 mm. maximum height.

Description: Thin, small; colour of periostracum light reddish-brown; umbos sharp, not extending beyond dorsal margin of shell; anterior teeth 14, posterior teeth 7.

Aspalima solator Iredale

Pl. 2, figs. 13, 14.

Aspalima solator Iredale, 1931, *Rec. Aust. Mus.,* 18: 204. Reference List No. 24.

Remarks: This species was described by a very brief comparative diagnosis with reference to *Aspalima erecta* (Hedley & Petterd, 1906). The latter is described in detail and well figured (*Rec. Aust. Mus.,* 6: 224, pl. 38, figs. 14, 15). A series of syntypes from 111 fm., 12½ miles east of Cape Byron, is in the Australian Museum, No. C. 19794 and the lectotype here figured is a single left valve, measuring approximately 2¾ mm. in maximum height and length.

Description: General shape as in *Aspalima erecta;* nearly equilateral, slightly oblique, almost as wide as high; concentric and radiating sculpture distinct and equally strong; six teeth, three on either side of the small, ill-defined triangular subumbonal pit; margin indistinctly crenulated.

Versipella soboles Iredale

Pl. 2, figs. 8, 9.

Versipella soboles Iredale, 1931, *Rec. Aust. Mus.,* 18: 203. Reference List No. 26.

Remarks: This species was described by a few brief comparisons with *Limopsis tenisoni* Tenison Woods. A holotype was selected, from 300 fm., 27½ miles east of Sydney Heads, presented to the Australian Museum by W. F. Petterd, No. C. 24366. It measures 24 mm. maximum length, 23 mm. maximum height. It appears to be very close to *Senectidens dannevigi* Iredale and any generic distinction between the two is quite unrecognisable by us. Macpherson and Gabriel (1962) consider *Versipella* to be a synonym of *Limopsis* Sasso.

Description: Shell very flat; shape identical with that of *S. dannevigi;* sculpture of irregularly spaced, flat concentric growth ridges, the umbonal area nearly smooth; radial sculpture of closely spaced grooves, more pronounced between the growth ridges than on them; colour pale yellow; periostracum tenacious, covered with thick, long bristles; ligamental area long, narrow; subumbonal pit small, well-defined; hinge plate broad; anterior teeth 9, posterior teeth 10, regularly radiating, the slope changing gradually from horizontal to vertical and back to horizontal; interior glossy white; margin smooth; posterior muscle scar less elongate and more dorsal than that of *dannevigi.*

Senectidens dannevigi Iredale

Pl. 3, figs. 1, 2.

Senectidens dannevigi Iredale, 1931, *Rec. Aust. Mus.,* 18: 204. Reference List No. 27.

Remarks: Iredale described this shell in a few lines by comparison with *Versipella soboles.* He did not mention a type specimen but in the Australian Museum collection a single live-taken shell from 80 fm. off Gabo Island, Victoria, collected F.I.S. "Endeavour," No. E. 4832, is labelled "*Senectidens dannevigi* Ire. Type" in Iredale's hand and is here selected as lectotype. It measures 27 mm. maximum length, 26 mm. maximum height.

Description: Shell flat, inequilateral; sculpture of close-set, well defined concentric growth ridges, crossed by very fine, close-set radiating grooves, not extending into the spaces between the growth ridges; umbos small, sharp, and extending beyond the dorsal margin; colour (in lectotype) pale yellow; ligamental area large, triangular; subumbonal pit small, ill-defined, larger than in *V. soboles;* hinge broad, anterior teeth 9, posterior teeth 13; slope of first three anterior teeth almost horizontal, the remainder suddenly steeply sloping to vertical; internal margin smooth; interior dull white; anterior adductor scar immediately under the outer anterior corner of the hinge; posterior muscle scars half way between the posterior of the hinge and the ventral margin.

Glycilima paradoxa Iredale

Pl. 3, figs. 3-5

Glycilima paradoxa Iredale, 1931, *Rec. Aust. Mus.,* 18: 204. Reference List No. 28.

Remarks: This species was described in some detail, and one of the differentiating characters was its lack of cancellate sculpture. However, the large valve here selected as lectotype shows faint radial rib sculpture crossing the concentric sculpture. The validity of the genus *Glycilima* is, as a consequence, doubtful. The syntypes consist of many dissociated valves from 100 fm., off Wollongong, New South Wales, presented C. Hedley, Australian Museum No. C. 62324. We have selected as lectotype the largest right valve (fig. 3) but as it is not in very good condition, we also figure a smaller, paralectotype left valve (figs. 4, 5).

Description: Shell almost equilateral; teeth 4 to 6 on each side (depending on maturity); surface with widely spaced growth ridges following the margin of the shell, crossed by faint, irregularly spaced radial ribs.

Abarbatia separata (Iredale)

(Not figured).

Barbatia (*pistachia*) *separata* Iredale, 1925, *Rec. Aust. Mus.,* 14: 249. Reference List No. 37.

Remarks: Iredale described this taxon as a deep-water subspecies of the sub-littoral *pistachia* Lamarck, giving a few differentiating characters. Unfortunately no specimens can be found in the Australian Museum collection which are recognisable as Iredale's syntypes, so that we can add nothing at present regarding this form.

Veletuceta thackwayi Iredale

Pl. 3, figs. 6, 7.

Veletuceta thackwayi Iredale, 1931, *Rec. Aust. Mus.,* 18: 203. Reference List No. 47.

Remarks: Iredale described this species and the next in a confusing set of comparisons with the nominal species *crebriliratus* Sowerby and *tenuicostatus* Reeve. Few distinguishing characters were given and comparison of series suggests to us that all the populations referred to may be conspecific. A series of three syntype right valves of *V. thackwayi,* from Port Stephens, New South Wales, presented by A. E. J. Thackway is in the Australian Museum, No. C. 62348 and we have selected as lectotype the largest valve which measures 22 mm. in length and 20 mm. in height. Macpherson and Gabriel (1962) do not accept *Veletuceta* as a genus distinct from *Glycymeris,* following Thiele (1934) and other workers; however Nicol (1956) indicates that *Veletuceta* may be an acceptable taxon.

Description: Shell rounded, slightly longer than high, posterior slightly angulated; shell light yellow-brown with a conspicuous lighter flame-like patch descending from the umbo, and with brown zig-zag lines (as in *V. flammea* Reeve); with a fine tenacious periostracum; sculpture of numerous, flatly-rounded radiating ribs (slightly less in number, broader and flatter than in *fossa* Iredale) overridden by very close-set, radiating striae which are more conspicuous on than between the ribs; growth lines faintly indicated by slightly lighter coloured concentric bands rather than ridges; concentric close set striae, more conspicuous on than between the radiating ribs, in combination with the radiating striae give the surface a finely granulated appearance; hinge plate narrow; teeth weak, 10 on either side; muscle scars elongate, adjacent to hinge plate; some specimens feature a dark brown coloration on, and descending from the anterior muscle scar; margin crenulated, but not as strongly as in *fossa* Iredale.

Veletuceta fossa Iredale

Pl. 3, figs. 8, 9.

Veletvceta fossa Iredale, 1931, *Rec. Aust. Mus.,* 18: 203. Reference List No. 48.

Remarks: The syntypes of this taxon include a large series of live taken specimens from 5 to 15 fm., off Gabo Island, Victoria, collected by Roy Bell, Australian Museum No. C. 62356. We have chosen as lectotype one of the largest measuring 20.5 mm. maximum length and 18.5 mm. maximum height.

Description: Shell almost round in outline; white with dense, fine, tenacious, silky light-brown periostracum; sculpture of numerous flatly-rounded radiating ribs, overridden by very fine close-set radiating striae on and between the ribs, crossed by widely spaced, ill-defined concentric growth ridges and extremely fine close-set concentric striae which are visible between the radiating striae; hinge plate deep; 10 teeth on each side; both muscle scars rounded, high up, adjacent to hinge; a well-defined red brown patch under the umbonal area on the dull white interior; margin strongly crenulated; ligamental area long, narrow.

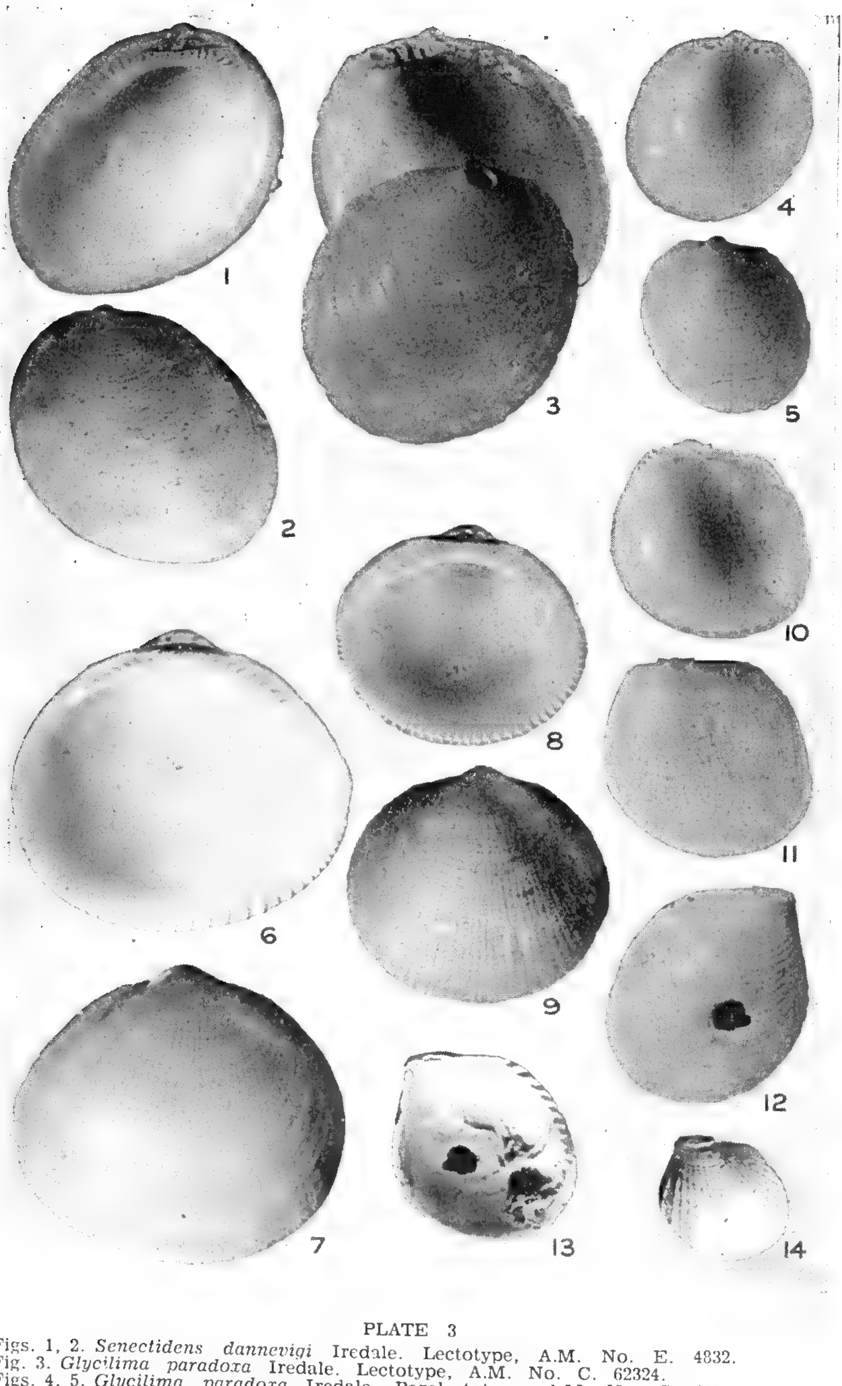


PLATE 3

Figs. 1, 2. *Senectidens dannevigi* Iredale. Lectotype, A.M. No. E. 4832.
Fig. 3. *Glycilima paradoxa* Iredale. Lectotype, A.M. No. C. 62324.
Figs. 4, 5. *Glycilima paradoxa* Iredale. Paralectotype, A.M. No. C. 62324.
Figs. 6, 7. *Veletuceta thackwayi* Iredale. Lectotype, A.M. No. C. 62348.
Figs. 8, 9. *Veletuceta fossa* Iredale. Lectotype, A.M. No. C. 62356.
Fig. 10. *Cosa pharetra* Iredale. Paralectotype, A.M. No. C. 18142.
Fig. 11. *Cosa pharetra* Iredale. Lectotype, A.M. No. C. 18142.
Figs. 12, 13. *Cosa sagana* Iredale. Lectotype, A.M. No. C. 18141.
Fig. 14. *Cosa sagana* Iredale. Paralectotype, A.M. No. C. 18141.

Cosa sagana Iredale

Pl. 3, figs. 12-14.

Cosa sagana Iredale, 1931, *Rec. Aust. Mus.*, 18: 204. Reference List No. 59.

Remarks: This species is briefly, but adequately described, so that additional descriptive matter is unnecessary. A syntype series in the Australian Museum, No. C. 18141 consists of numerous dissociated valves, from 100 fm., off Wollongong, New South Wales, presented by C. Hedley. A large, slightly damaged right valve is selected as lectotype and figured (figs. 12, 13); it measures approximately 2.5 mm. in maximum length and height. A smaller, left paralectotype valve is also figured, (fig. 14). Laseron (1953) briefly reviewed the status of the genus *Cosa* in New South Wales. Thiele (1934) regarded *Cosa* as a section of *Philobrya.*

Cosa pharetra Iredale

Pl. 3, figs. 10, 11.

Cosa pharetra Iredale, 1931, *Rec. Aust. Mus.*, 18: 204. Reference List No. 61.

Remarks: This species also was adequately described and no additional comments are necessary. Both *Cosa* species seem fairly distinctive from the other named species on the New South Wales List, but revision of the group is desirable. The syntype series consists of numerous isolated valves from 100 fm. off Wollongong, New South Wales, presented by C. Hedley, Australian Museum, No. C. 18142. A left valve (fig. 11) is selected as lectotype; it measures approximately 2¼ mm. in maximum height and maximum length. A right paralectotype valve is also illustrated (fig. 10).

ACKNOWLEDGEMENTS

The assistance of Messrs. A. Healy and F. J. Beeman in the preparation of the plates is gratefully acknowledged. The Sydney Branch of the Malacological Society of Australia has met the cost of preparation of illustrations and blocks, for which we are grateful.

REFERENCES

DELL, R. K., 1956. The Archibenthal Mollusca of New Zealand. *Bull. Dom. Mus. N.Z.*, 18: 1-235.

FLEMING, C. A., 1957. The genus *Pecten* in New Zealand. *Palaeont. Bull. N.Z.*, 26: 1-69.

HEDLEY, C., 1913. Studies on Australian Mollusca. Part 11. *Proc. Linn. Soc. N.S.W.*, 38: 258-339.

HEDLEY, C., 1918. A Check-List of the Marine Fauna of New South Wales. Part 1. Mollusca. *J. Roy. Soc. N.S.W.*. 51, Suppl., pp. M1-M120.

IREDALE, T. and McMICHAEL, D. F., 1962. A Reference List of the Marine Mollusca of New South Wales. *Mem. Aust. Mus.*, 11: 1-109.

LASERON, C. F., 1953. Minute bivalves from New South Wales. *Rec. Aust. Mus.*, 23: 33-53.

LAURSEN, D., 1953. The genus *Ianthina*. *Dana Rep.*, 38.

McMICHAEL, D. F., 1964. The genus *Amimopina* Iredale, 1933. *Nautilus*, 78: 52-54.

MACPHERSON, J. H., and GABRIEL, C. J., 1962. *Marine Molluscs of Victoria.* University of Melbourne and National Museum, Melbourne.

NICOL, D., 1956. Distribution of living glycymerids with a new species from Bermuda. *Nautilus*, 70: 48-53.

THIELE, J., 1934. *Handbuch der Systematischen Weichtierkunde.* (Part 3). Gustav Fischer, Jena.

DESCRIPTIONS OF AUSTRALIAN EOLIDACEA (MOLLUSCA: OPISTHOBRANCHIA)

4. THE GENERA *PLEUROLIDIA, FIONA, LEARCHIS* AND *CERBERILLA* FROM LORD HOWE ISLAND.

By ROBERT BURN*

Text fig. 1-16.

SUMMARY

For the first time, eolids are reported from Lord Howe Island in the Tasman Sea. One new genus, *Pleurolidia,* and two new species, *P. juliae* and *Learchis howensis,* are described. *Pleurolidia* is also recorded from Queensland. The records of *Cerberilla longicirrha* Bergh and *Cerberilla affinis* Bergh are the first since the original descriptions. *Fiona pinnata* (Eschscholtz) is a common pelagic species.

INTRODUCTION

Lord Howe Island (159° 20' East, 31° 20' South) is situated in the northern Tasman Sea some 300 miles due east of Port Macquarie, New South Wales. The marine fauna is tropical and zoogeographically related to that of New Caledonia (Iredale and Allan, 1940).

The species described below all belong to the Australian Museum, Sydney (A.M. in text). They have been collected over a number of years by various persons and to my knowledge are the first records of this suborder from the island. Notes on the living animals and their habitats accompany only *Cerberilla affinis.*

The writer is indebted to Dr. D. F. McMichael, Australian Museum, Sydney, for the loan of this material, and to the National Museum of Victoria, Melbourne, for assistance with literature. In particular, the writer wishes to thank the Trustees of the Science and Industry Endowment Fund, C.S.I.R.O., for a grant to aid research on the Australian opisthobranchs. This is a further part of a comprehensive study of the Opisthobranchia of Australia being undertaken by the writer.

SYSTEMATIC SECTION

ORDER NUDIBRANCHIA

SUBORDER EOLIDACEA

SUPERFAMILY PLEUROPROCTA

FAMILY PLEUROLIDIIDAE nov.

Two specimens of an unusual eolid species from Lord Howe Island and Queensland have a combination of characteristics which denies them a place among the present systematic classification of the Eolidacea. It is obvious from the lateral position of the anus below the vestigial notal brim that they belong to the suborder Pleuroprocta (Odhner, 1939: 50, 54). The position of the renal pore between the anus and the genital aperture is in common with the family Coryphellidae where however the cerata are always set in rows or crowded together along either

* Hon. Associate in Conchology, National Museum of Victoria, Melbourne, Victoria.

side of the notum. A single row of cerata along the notal brim as in the two specimens recalls the family Notaeolidiidae, from which they are separated by their triseriate radula. Like Notaeolidiidae, they have smooth masticatory borders to the jaws.

It is in the triseriate radula that the most important characteristic of the specimens lies. The horn-shaped lateral teeth are smooth, a feature not unknown in the Coryphellidae and therefore not of major consequence. The rhachidian, however, differs from all known Pleuroproct species (where it is cuspidate and laterally denticulate) in that it is rectinate or comb-like. This alone suggests a relationship to the Cleioproct Aeolidiidae. But it is not so because of the lateral anus (exception *Protaeolidiella*), the single row of cerata along the notal brim (exception *Aeolidiopsis*), the separate spermathecal aperture into the genital atrium, the slender foot, and lastly the triseriate nature of the radula. In *Protaeolidiella* Baba (1955: 53) the anus opens below or lateral to the cerata but as there is no notal brim, this situation is considered cleioproctic. In *Aeolidiopsis* Pruvot-Fol (1956: 228) the cerata lie in a single row along either side of the notum and the anus opens in the right notal area. The tooth of *Aeolidiopsis* (loc. cit.: 229, fig. 8) is nearest in shape to that of the present two specimens.

It therefore becomes necessary to create a position for this eolid species. A new family PLEUROLIDIIDAE of the sub-order Pleuroprocta is proposed for this species alone and its new genus *Pleurolidia*. The characteristics of *Pleurolidia* (pleuro—from pleuroproct, i.e. side anus, and lidia—from *Aeolidiopsis*, to indicate radular convergence) are listed below; when more material is available, a reconsideration may be necessary.

PLEUROLIDIA gen. nov.

Pleuroproct Eolidacea with a triseriate radula (rhachidian pectinate, laterals smooth) and smooth masticatory borders; anus in anterior third of body length, renal pore a little in front; with rugose rhinophores and rounded foot corners; with notal brim bearing a single row of cerata, the latter with a low keel or rib on dorsal and ventral sides; penis knob-like, vas deferens prostatic, spermatheca and oviduct with separate apertures (connection probably external); nerve ring with short pedal and parapedal commissures.

Type species: *Pleurolidia juliae* sp. nov.

Pleurolidia probably occupies a specialized ecological position. Both collectors who have taken it are noted underwater divers, thus it may live in deeper water.

Pleurolidia juliae sp. nov.

Figures 1-6.

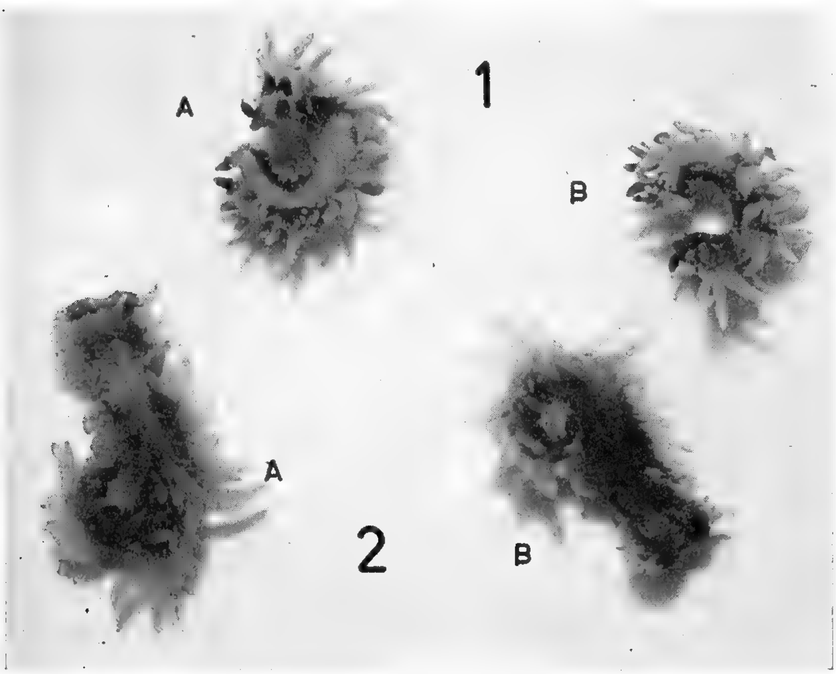
Material: 'The Brook', Lord Howe Island, July 1962, 1 specimen, Julie Booth, A.M. reg. no. C. 65661 (Holotype). Heron Island, Capricorn Group, Queensland, 1 specimen, Keith Gillett, A.M. reg. no. C. 65662.
Habitat: Not known.

Description: The Holotype (Fig. 1A-1B) is a curled slug which straightened measures about 12 mm. in length (the tail tip is missing). Preserved colouration is dull pink, everywhere on the body with superficial black pigment, darker around the head, along the back and in the furrow or fold between the sides and the foot margins; tentacles and rhinophores black with cream tips; many of the cerata with a reddish brown band varying from three-quarters to one-third the ceras length, always with a cream tip. The second specimen (Fig. 2A-2B) is more red than pink in colour with a heavier superficial black pigment; it is 16 mm. in length.

The body (Fig. 3) is long, slender and high in section. The foot is as wide as the body, anteriorly rounded, the margins narrow but distinct. The head extends well forward of the foot; it is ventrally concave with a rim-like edge. The tentacles are short, their bases well behind the anterior edge of the head. The rhinophores are short, conical, wrinkled and granulated, their bases approximating. Cerata elongate, constricted in some above the second-third, non-caducous, each with a low slender keel on the dorsal and ventral sides; cnidosacs elongate, conical. Cerata in about ten groups on each side, set in a single row along a vestigial notal brim. In the Holotype, the groups are distinct anteriorly but in the spaces, liver ducts are visible reaching to the notal brim; the right liver consists of five cerata, the first branch of the posterior liver has four. In the second specimen, small secondary cerata line the notal brim between the anterior groups. Genital aperture (g) below the first group of cerata on the right side, anus (a) below second group, at two-thirds of distance between foot and cerata, renal pore (r) a little in front of and above the anus.

The small 1 mm. long yellow-brown jaws (Fig. 4) are very convex, triangulate, highest at anterior third; the masticatory borders are short and smooth. The slender radula (Fig. 5) has 32 rows of 1.1.1 teeth. Rhachidian pectinate, not greatly curved, with 10-11 colourless denticles on a yellow base. The majority of the denticles are long and slender, the outermost pair on each side have a web-like flange between them to about half length. The colourless lateral teeth are horn-shaped with a narrow basal flange; they are smooth.

The genital atrium (Fig. 6) of the Holotype was partially everted. Besides the penis (p) which projects slightly, there is a small anterior



pit which is the aperture of the muscular spermatheca (s). The oviduct (o) opens through a slender pore just behind the penis. The penis is knob-like with a seminal aperture on the dorsal edge; the vas deferens (v) is short, prostatic and a little winding. The entire spermatheca was not properly observed; it lies beside the penal sheath. There is no ampulla on the hermaphrodite duct. There is probably an external connection between the spermatheca and oviduct, as indicated in the figure.

The nerve ring is more concentrated than in *Notaeolidia robsoni* Odhner (1934: 282, fig. 48) with larger pedal ganglia and shorter pedal and parapedal commissures.

Discussion: The description set out above refers wholly to the Holotype specimen except where otherwise stated. The pharyngeal bulb of the second specimen was unfortunately misplaced during a preliminary examination some years ago, thus no details of it are known. Certain minor differences between the Holotype and the second specimen exist which suggest that the two might not be conspecific, but lack of material precludes any argument in this direction.

The species is named after Miss Julie Booth of Fairfax Island, Queensland, formerly of Lord Howe Island, the collector of the Holotype.

SUPERFAMILY ACLEIOPROCTA

FAMILY FIONIDAE

Fiona pinnata (Eschscholtz)

Eolis pinnata Eschscholtz, 1831: 14, pl. 19, fig. 1.

Fiona pinnata. Bennett, 1966: 46, pl. 11, lower fig., pl. 12.

Material: Lord Howe Island, Tasman Sea: August 1962, 3 specimens, Julie Booth, A.M. reg. no. C. 63089; North Bay, May 1964, 5 specimens, Isobel Bennett, A.M. reg. no. C. 63090.

Habitat: On floating objects such as bottles, cuttle bones and logs upon which the stalked barnacle, *Lepas* spp., grow, and on the Siphonophore, *Velella*.

Remarks: This is a very common pelagic species, often washed ashore during heavy weather. The slightly-coiled egg mass is found attached to the object or *Velella* upon which the animals live.

F. pinnata is present in collections of opisthobranchs from most parts of Australia now before the writer. A report on these specimens will be published at a later time.

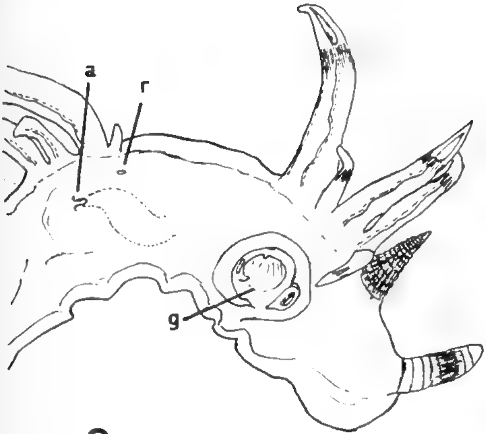
SUPERFAMILY CLEIOPROCTA

FAMILY FACELINIDAE

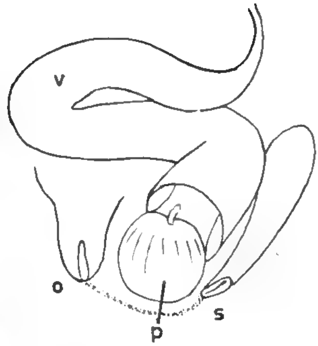
Genus *LEARCHIS* Bergh (1896: 385)

According to Marcus and Marcus (1960: 182), this genus is defined as follows: "Penis blunt or conical, unarmed and without appendages; jaw with denticulated masticatory border and without dorsal indentation; radular tooth with smooth median cusp flanked by at least 3 denticles; anterior angles of foot produced."

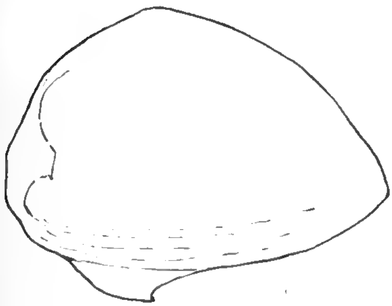
Type species: *Learchis indica* Bergh (1896: 386).



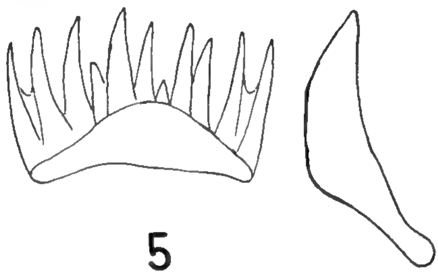
3



6



4



5

Remarks: The specimens described below fulfil all aspects of this generic diagnosis. They are in particular accord with *L. indica* in that the cerata of the posterior liver form groups of parallel rows. In *L. poica* Marcus and Marcus (1960: 183), the cerata of the posterior liver are in arches.

Aeolidia dangeri Risbec (1928: 252; 1953: 136) also belongs to *Learchis* (Marcus, 1958: 58; Marcus and Marcus, 1960: 183). Contrary to the latter authors' opinions (loc. cit.), *Rizzolia australis* Bergh (1884: 27) belongs not to *Learchis* but is a synonym of the Favorinidae *Austraeolis ornata* (Angas, 1864; Burn, 1966: 31).

Learchis howensis sp. nov.

Figures 7-10.

Material: South reef, Lagoon, Lord Howe Island, 2 January 1938, 2 specimens, Joyce Allan and R. Baxter, A.M. reg. nos. C. 65663 (Holotype) and C. 65664 (Paratype).

Habitat: Not known.

Description: The Holotype (Fig. 7) is the smaller of two well preserved slugs; it measures 7 mm. in length, the Paratype (Fig. 8) 9 mm. Body colour dull orange, the upper half of the digestive glands in the cerata black pigmented, the upper half of the cerata and the cnidosac white.

The body is slender and high, and is probably much longer in life. The narrow foot has strong tentaculiform anterior corners. Tentacles short, tapering. Rhinophores with six to eight annulae. Cerata long, carrot-shaped, cnidosacs small, fusiform. Liver system with five rows of 2, 3, 4, 4, 6 cerata in the right liver, behind which lie eight rows of 2 to 5 cerata (first posterior liver group right side) followed by five to seven single rows of 2 to 5 cerata. The genital aperture lies below the space of the fourth and fifth rows of the right liver. The anus emerges behind the second row of the posterior liver group on the right side.

The 0.9 mm. long brown jaws (Fig. 9) are broadly oval, narrower behind; masticatory borders with 20 strong, truncate denticles. Radular teeth (Fig. 10) 17, brown in colour, cusp prominent, lateral denticles six each side, base of teeth broad.

Penial spines or papillae were not observed in either specimen. The male copulatory organ comprises muscular penial sheath containing the short blunt evaginable penis.

Discussion: *L. howensis* is the first record of the genus from the Australian area. *L. indica* Bergh (1896: 386) differs from *L. howensis* by having more rows of cerata in the right liver and more groups behind, and fewer denticles on the posteriorly tapering jaws. *L. poica* Marcus and Marcus (1960: 183) has the posterior liver formed into arches and subquadrate jaws. *L. dangeri* (Risbec, 1928: 252) has red cerata with a blue band and yellow cap to each and smooth rhinophores.

Facelina newcombi (Angas, 1864; Burn, 1962: 114) from south-eastern Australia has black pigmented digestive glands and liver branchings identical to those of *L. howensis*. It is separated by a ring of spines on the penis and more elongate jaws. *F. bouraill*i (Risbec, 1928: 254; 1953: 147) from New Caledonia has shorter cerata than the new species and a complex papillate penis.

FAMILY AEOLIDIIDAE

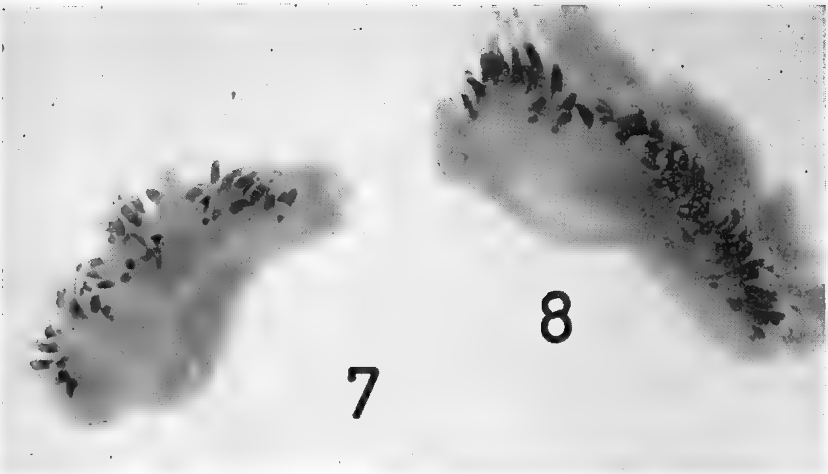
A uniseriate radula of pectinate teeth is the decisive characteristic of this family.

Genus *CERBERILLA* Bergh (1873: 160).

The high marginal denticle or denticles of the radular teeth distinguishes this genus from all others of the family. Other characteristics are less important. Radula short and not tapering. Foot wider than body with distinct tentaculiform anterior corners. Tentacles long, sometimes half body length. Rhinophores contiguous, small, cylindrical, smooth, near to anterior of head. Body broad; cerata in anterior liver branches short, leaving middle of dorsum bare, those behind longer, crowded together in middle line. Right liver an arch of two rows. Pleuroproctic anus below or behind third row of cerata of posterior liver right side. Penis large, unarmed.

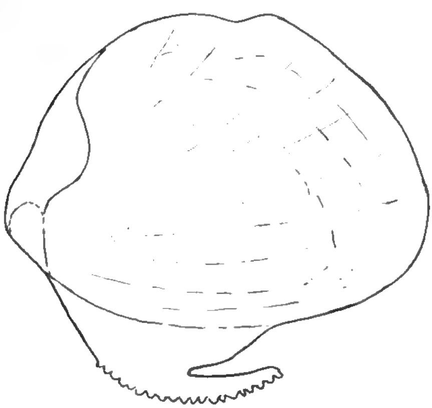
Type species: *Cerberilla longicirrha* Bergh (1873: 161).

There are nine species attributed to *Cerberilla* (Tardy, 1965: 16, 19) plus the variety *affinis* Bergh (1889: 684) here described as a distinct species. In the past, the radular teeth have provided the basis for specific identification (Pruvot-Fol, 1934: 52). These do vary considerably, not so much in actual shape but in the numbers of major denticles in different teeth of the same radular. From study of the various figures and descriptions of the radulae, five species have an almost identical shape

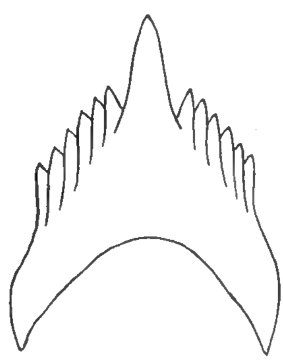


of the teeth, i.e. *longicirrha, annulata, affinis, africana, moebii,* by which it is most difficult to separate them. Therefore other characteristics such as colour, shape of the right liver and number and shape of the cerata must be utilized. The remaining five species, i.e. *ambonensis, tanna, asamusiensis, pungoarena, bernadettae,* have quite distinctive radular teeth to distinguish them.

Bergh (1889: 685) was the first to point out that the right liver in this genus formed an arch. No other reference to the right liver occurs in the literature until Tardy (1965) described the Atlantic French coast species, *C. bernadettae* (Note: Ending here amended to feminine genitive "ae" for this species dedicated to Madame Bernadette Tardy, loc. cit.: 11). There the right liver is formed of two simple rows. The two specimens of *C. longicirrha* described below have an arch in the right liver with two rows of cerata in the anterior leg. *C. affinis* has an arch



9



10

also, in this instance with five rows of cerata in the anterior leg and a trace of two rows in the posterior leg. Thus, according to the shape of the right liver, some of the species can be distinguished as follows.

Right liver an arch .... 1.

Right liver two simple rows ....

C. annulata (Quoy and Gaimard, 1832).
C. moebii (Bergh, 1888).
C. bernadettae Tardy (1965).

1. Five rows of cerata in anterior leg

C. affinis Bergh (1889).

Two rows of cerata in anterior leg

C. longicirrha Bergh (1873).

C. tanna Marcus and Marcus (1959) and *C. ambonensis* Bergh (1905) probably have two simple rows in the right liver. The other three species, *C. africana* Eliot (1903), *C. asamusiensis* Baba (1940) and *C. pungoarena* Collier and Farmer (1964) have neither indication of the right liver nor position of the anus in their descriptions.

Tardy (1965: 18) considers *Cerberilla* to be a somewhat primitive eolid genus. A pleuroproct anus is already known in the Aeolidiidae, viz. *Protaeolidia* Baba (1955: 31, 53). But in neither genus is there a notal brim; therefore this situation is considered an adaptation of the cleioproctic anus. The structure of the digestive gland (liver branching) with an arch or two simple rows in the right liver can hardly be primitive, though it may be said that the multiplicity of cerata in the anterior leg of the right liver of *C. affinis* suggests a more primitive ancestor than such species as have only a simple row in the anterior leg. The *Philine*-like shape of the egg-ring of *C. bernadettae* is surely a special acquisition due to the peculiar habitat of the species and not a carry-over from an ancestoral form.

Very few specimens of the various species are known. The discovery that two species, *C. pungoarena* Collier and Farmer (1964: 391) and *C. bernadettae* Tardy (1965), burrow in sandy-mud and sand respectively probably accounts for this scarcity of specimens. *C. affinis* Bergh (1889) evidently burrows in sand also.

A possible member of *Cerberilla* is *Aeolis longibranchus* Volodchenko (1941: 59, 67, pl. 3, fig. 5, pl. 4, fig. 5). The meagre description and the figures indicate an animal somewhat like the species of this genus. The radular teeth have a straight anterior edge bearing 48-50 alternately large and small denticles and no high marginal denticles. This writer's later work (1955) dealing with the opisthobranchs has not been seen.

Cerberilla longicirrha Bergh.

Figures 11-13.

Cerberilla longicirrha Bergh, 1873: 161, pl. 12, fig. 6-16; 1874: 115; pl. 3, fig. 1-3; 1876: 653.

Material: Reef at Ned's Beach, Lord Howe Island, Tasman Sea, 16 December 1937, 2 specimens, R. Baxter, A.M. reg. no. C. 63091.

Habitat: Not known.

Description: The two specimens (Fig. 11) are 25 and 22 mm. in length. In colour they are dull yellowish pink with red-brown tips to the rhinophores, dorsally dark brown tentacles with a line of the same colour running back from each to the rhinophores, a narrow dark brown band at the base of the anteriormost cerata, and with a dark brown patch or transverse stripe just below the tip of some of the larger median area cerata.

The body is as high as wide and rather elongated, the foot much broader with distinct tentaculiform anterior corners. Tentacles about half as long as body, extremities very fine. Rhinophores small, cylindrical, smooth in one specimen and wrinkled in the other, bases contiguous,

near to front of head. Liver branches each side one small anterior arch (right liver and partner) and 17 oblique rows of up to 14 cerata. Largest cerata slender and long, 1 mm. diameter by up to 16 mm. length, oval in section, with small vertical basal flange on anterior side. Cerata in right liver in two rows on anterior leg, in single row on posterior leg; all other rows single. Genital aperture below posterior leg of right liver, anus low down between third and fourth rows of posterior liver right side, renal pore below preanal row.

11

Anterior arches of cerata in line with rhinophores. Median part of dorsum bare to fifth row of cerata of the posterior liver, thereafter median division hard to discern.

Jaws (Fig. 12) brown, 3.3. mm. long, elongate oval, rather broader than in the type specimen and with half as long again smooth masticatory borders. Radular teeth (Fig. 13) brownish, 0.5 mm. wide, 13 in number, each with 10-16 major denticles. Accessory denticles stand between and on the sides of the central 2-4 major denticles. The large marginal denticle at each side is lower than those in the middle.

Discussion: Like the original specimen, the present slugs have two rows of cerata in the anterior leg of the right liver and a single row in the posterior leg. Body shape, colouration and radular teeth are very similar also. Thus there is no hesitation in identifying these specimens with *C. longicirrha*.

This is the first record of this species since Bergh described it from Samoa in 1873. It is a new record for both Lord Howe Island and the Australasian region.

Cerberilla affinis Bergh.

Figures 14-16.

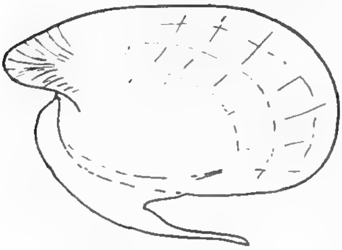
Cerberilla annulata (Quoy and Gaimard) var. *affinis* Bergh, 1889: 684, pl. 16, fig. 15-16, pl. 17, fig. 6-9, pl. 18, fig. 7; 1890: 880.

Material: Salmon Beach, Lord Howe Island, Tasman Sea, 20 June 1966, 1 specimen plus colour transparencies and black and white prints, Harold Cogger, A.M. reg. no. C. 65517.

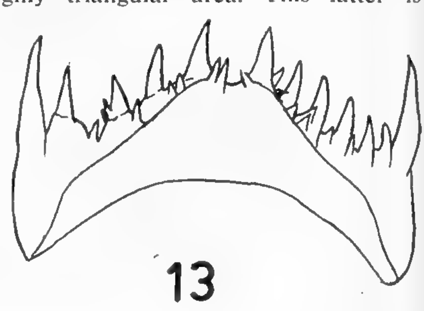
Habitat: Reef flat, 2 feet of water.

Description: The well-relaxed preserved slug measures 40 mm. overall length and 23 mm. over the cerata. The tapering sole is 38 mm. long and 16 mm. at its widest of which there is a 5 mm. wide thin foot margin set off on each side by a shallow groove. The rhinophores are 5 mm. high, the tentacles are 12 mm. long and the tentaculiform foot corners about 4 mm. The largest cerata measures 25 mm. in length and 1 mm. in major diameter. The everted penis is 12 mm. long.

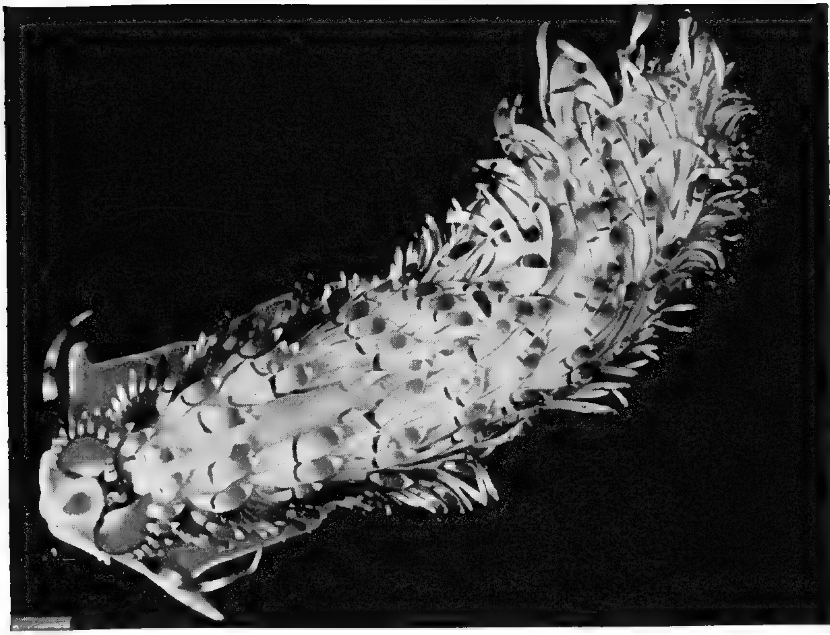
The living animal (Fig. 14) is a spectacular sight with a complex patterning. The body is a bluish opaque white with the visible dorsum brownish. The foot is outlined with citron-yellow. A citron-yellow margin connects the tentacles which have a dark grey base, then successively bands of yellow, grey-brown, white, navy blue and blue-white. The rhinophores have a grey-brown basal half, then a yellow band, a narrow navy blue ring, a blue-white ring, a navy blue ring and a blue-white tip. Around the base of the rhinophores is a black circle from which run forward a pair of black lines to the veil between the tentacles and thus forming a roughly triangular area. This latter is



12



13



orange nearest the rhinophores, greyish in the anterior corners and marked by a large dark grey oval spot in the middle line.

At each side of the rhinophores there is a large dark grey quarter circle with cerata attached to the posterior and lateral edge. These cerata have a narrow black ring at the base, are then yellow followed by a wide band of grey and a yellow tip. In successive rows where the cerata are longer, the base is white or grey, rarely black, at the second-third is the black ring followed by yellow band, wide grey band and yellow tip. The long posterior cerata are bluish white except for the upper 5-6 mm. where there is the black ring, narrow yellow band, wider grey band and yellow tip. Some of the long cerata, particularly those in the second quarter of the row, have the grey band nearly black in shade; the cerata of the first or middle line quarter have a very pale wide grey band and those of the outer or lateral half of the row have just the yellow tip below which is sometimes a bluish spot, band or ring. The outermost small cerata which lie nearest the foot are dark brown, thus laterally there appears a brown stripe along the animal.

The body is as usual in the genus with a prominent buccal collar projecting beyond the head, a wide foot with tentaculiform corners and bilabiate anterior margin, and simple cylindrical rhinophores with contiguous bases. The tentacles are slender with small bases; in life they appear not to project forward of the head but to lie curved back or tucked into the furrow between foot and cerata. The dorsum is visible in the live slug to the level of the seventh row of the posterior liver. The cerata stand upon laterally prominent peduncles. The right liver comprises a peculiar arch the anterior leg of which is basically the quarter circle beside the rhinophore and the posterior leg appears as the row immediately behind. The anterior leg when folded up reveals a row of larger cerata along the upper edge and four rows of alternately placed, posteriorly diminishing yellow cerata rising from the underside of the quarter circle.

These are more dense towards the lateral end of the leg. The posterior leg of the right liver has a single row of cerata except at the very lateral end where a second row of three or four small cerata appears. Thereafter follows 23 rows of cerata. The cerata are flat in section and lie closely upon each other. The anterior cerata are smallest in number and size, those nearest the middle line are, anteriorly, very broad and, posteriorly, very slender and long; the tip containing the ovoid cnidosac spatulate. Bifid, trifid and quadrifid cerata occur without reason. The cerata in the rows of the posterior liver have an anterior basal flange.

The genital pore with the large everted penis lies below the posterior leg of the right liver. The penis is tapering and unarmed. The anus opens below the fourth row of the posterior liver on the right side.

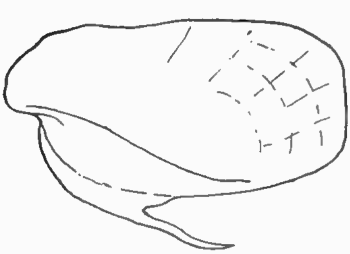
The pale brown 5 mm. long jaws are rather more quadrate than oval, being high anteriorly and posteriorly. The masticatory borders are smooth. The radula has 14 glassy teeth, each 0.7 mm. wide. These have 12-16 major denticles with accessory denticles between and on the sides of the central four major denticles. The large marginal denticle each side is lower than those in the middle. One tooth has one major denticle missing from next to the middle line.

Discussion: An enquiry directed to the collector resulted in the following information relating to the habitat. "Low tide, on reef flat in 2 feet of water, 40 yards from shore, animal crawling over patch of dead algae-covered coral in an open bright sunny area. Placed in plastic bag with seawater, animal made directly for small quantity of sand in bottom. This was insufficient to burrow in but it completely covered itself with sand grains which adhered to its body. It stayed like this for several days until return to Sydney."

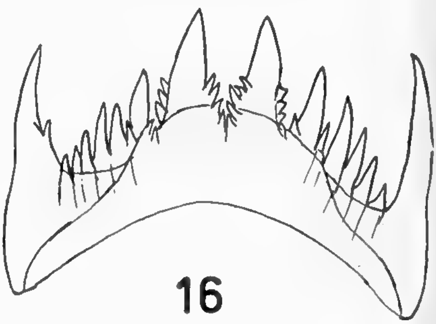
From this observation of the animal and the sand in the plastic bag, it is fairly obvious that *C. affinis,* like *C. pungoarena* and *C. bernadettae,* is a sand-burrowing species.

The animal is a truly magnificent spectacle in life. Dr. D. F. McMichael when forwarding the specimen to me wrote (28. vi. 1966), "I would say that this animal was one of the most spectacular marine organisms I have had the chance to see." The colour transparencies accompanying it bear out his comment. Mr. Harold Cogger, Australian Museum, Sydney, is to be congratulated for his foresight in bringing the live animal to Sydney so that it could be observed, photographed, properly relaxed and preserved.

At first the specimen was regarded as a new species. However its characteristics of five rows of cerata in the anterior leg of the right liver, the number of cerata and cerata rows, coloration, size and general shape of the radular teeth are too similar to *C. affinis* for effective separation. If such separation is considered in the future, then stress



15



16

should be laid upon the position of the genital aperture below the posterior leg of the right liver, the position of the anus below the fourth row of the posterior liver on the right side, the quadrate jaws and the number of accessory denticle-bearing major denticles of the radular teeth.

Bergh's specimen for Polo-Edam in eastern Indonesia (1889: 684) was originally described as a variety of *C. annulata* (Quoy and Gaimard, 1832). The form of the right liver in this species is two single rows (Bergh, 1876: 654), the genital aperture lies below the first row of the right side posterior liver, and the living animal is white with black on the head, violet tips to the rhinophores, and the cerata with yellow and black bands. It is therefore necessary to promote *affinis* to full specific status.

The black circle at each side of the rhinophores in *C. moebii* (Bergh, 1888: pl. 81, fig. 1) is somewhat similar to the markings of the present specimen. Much longer rhinophores, different coloration and a right liver formed of two rows separate the former from *C. affinis*.

This is the first record of the species since the original description in 1889. It is a new record for both Lord Howe Island and the Australasian region. It is peculiar that two species of this rare genus should occur at the one isolated locality.

REFERENCES

BABA, K., 1955. *Opisthobranchia of Sagami Bay*. Suppl. 59 pp. 20 pls. Iwanami Shoten, Tokyo

BENNETT, I., 1966. Some pelagic molluscs and associated animals in south-eastern Australian waters. *J. Malac. Soc. Aust.*, 9: 40-51, pl. 8-13.

BERGH, R., 1873. Neue Nacktschnecken der Südsee, Malacologische Untersuchungen. *J. Mus. Godeffroy*, 1: 137-168, pl. 9-12.

———, 1874. Ibid. II. *Ibid.*, 3: 91-116, pl. 1-4.

———, 1876. Beiträge zur Kenntnisss der Aeolidiaden, III. *Verhandl. Zool. Bot. Ges. Wien*, 1875, 25: 633-658, pl. 13-15.

———, 1884. Report on the Nudibranchiata. *Rep. Sci. Res. Challenger, Zool.*, 10: 1-154, pl. 1-14.

———, 1888. Nudibranchien vom Meere der Insel Mauritius. *Malacologische Untersuchungen*, (Semper, C., *Reisen im Archipel der Philippinen.*). 3(16,i): 755-814, pl. 77-81.

———, 1889. Beiträge zur Kenntniss der Aeolidiaden, IX. *Verhandl. Zool. Bot. Ges. Wien*, 1888, 38: 673-706, pl. 16-20.

———, 1890. Die Nudibranchien des Sunda-Meeres. *Malacologische Untersuchungen*. (Semper, C., *Reisen im Archipel der Philippinen*). 3(17): 873-991, pl. 85-89.

———, 1896. Eolidiens d'Amboine. *Rev. Suisse Zool.*, 4(2): 385-394, pl. 16.

BURN, R., 1962. Descriptions of Victorian Nudibranchiate Mollusca, etc. *Mem. Nat. Mus., Melb.*, 25: 95-128.

———, 1966. Descriptions of Australian Eolidacea, 3. The genera *Tularia, Embletonia* and *Austraeolis*, etc. *J. Malac. Soc. Aust.*, 9: 25-35.

COLLIER, C. and FARMER, W., 1964. Additions to the nudibranch fauna of the East Pacific and the Gulf of California. *Trans. S. Diego Soc. Nat. Hist.*, 13(19): 377-396.

ESCHSCHOLTZ, F., 1831. *Zool. Atlas*.

IREDALE, T. and ALLAN, J., 1940. A review of the relationships of the Mollusca of Lord Howe Island. *Aust. Zool.*, 9: 444-451

MARCUS, E., 1958. On western Atlantic Opisthobranchiate Gastropods. *Amer. Mus. Novit.*, no. 1906, 82 pp.

MARCUS, E. and E., 1959. Some Opisthobranchs from the north-western Gulf of Mexico. *Publ. Inst. Mar. Sci. Univ. Tex.*, 7: 251-261, 3 pl.

————, 1960. Opisthobranchs from American Atlantic warm waters. *Bull. Mar. Sci. Gulf and Caribb.*, 10(2): 129-203.

ODHNER, N., 1934. The Nudibranchiata. *Brit. Antarct.* (*"Terra Nova"*) *Exped., 1910* Zool., 7(5): 229-310, 3 pl.

————, 1939. Opisthobranchiate Mollusca from the western and northern coasts of Norway. *K. Norske Vidensk. Selsk. Skr.*, 1939(1): 1-93.

PRUVOT-FOL., A., 1934. Les opisthobranches de Quoy et Gaimard *Arch. Mus. Hist. Nat.*, (6), 11: 13-92: pl. 1.

————, 1956. Un aeolidien des mers tropicales, *Aeolidiopsis ransoni* n.g., n. sp. *Bull. Mus. Hist. Nat., Paris,* (2), 28(2): 228-231.

RISBEC, J., 1928. Contribution à l'étude des Nudibranches Néo-Calédoniens. *Faune Colon. Franc.*, 2: 1-328, pl. A-D, 1-12.

————, 1953. Mollusques nudibranches de la Nouvelle-Calédonie. *Faune Un. Franc.*, 15: 1-189.

TARDY, J., 1965. Description et biologie de *Cerberilla bernadetti*, espèce nouvelle . . . . de la côte atlantique française. *Bull. Inst. Océanogr. Monaco,* 65, no. 1349, 22 pp., 6 pl.

VOLODCHENKO, N., 1941. New nudibranchiate Molluscs from the Seas of the far-east of the U.S.S.R. *Invest. Far East. Seas U.S.S.R.*, 1: 53-68, pl. 1-4.

EXPLANATION OF FIGURES

Fig. 1-6. *Pleurolidia juliae* sp. nov.
Fig. 1. Holotype, from left (A), from right (B).
Fig. 2. Second specimen, from above (A), from below (B).
Fig. 3. Right side of Holotype, anterior end.
Fig. 4. Left jaw from outside.
Fig. 5. Radula.
Fig. 6. Anterior parts of genital organs.
Fig. 7-10. *Learchis howensis* sp. nov.
Fig. 7. Holotype, from left.
Fig. 8. Paratype, from left.
Fig. 9. Left jaw from outside.
Fig. 10. Radula.
Fig. 11-13. *Cerberilla longicirrha* Bergh.
Fig. 11. Two specimens from right.
Fig. 12. Left jaw from outside.
Fig. 13. Radula.
Fig. 14-16. *Cerberilla affinis* Bergh.
Fig. 14. Living slug from above; photo A. Healy.
Fig. 15. Left jaw from outside.
Fig. 16. Radula.

Abbreviations: *a—anus; g—genital aperture; o—oviduct; r—renal pore; s—spermatheca; v—vas deferens.*

ON A SUBTERRANEAN SNAIL AND A TORNID FROM NEW ZEALAND

By W. F. PONDER*

Pls. 4, 5.

Abstract: A new genus is created for a new species of hydrobiid snail from a cave in East Takaka, Nelson. A new tornid from the littoral zone of the Wellington West Coast, which is tentatively placed in the genus *Cochliolepis* Stimpson, is described. The radula and operculum of both species are described together with notes on the animal.

FAMILY HYDROBIIDAE

GENUS *OPACUINCOLA* n. gen.

Type species: *Opacuincola caeca* n. sp.

Diagnosis: Shell smooth, small, globose, spire short, aperture oval, outer lip not much retracted, umbilicate. Operculum thin, horny, of a few spirals. Radula with a moderately large central tooth with lateral flanges which bear a few denticles; cutting edge with several rather weak cusps. Lateral tooth short, with moderately large cusps. Marginal teeth elongate, finely serrate or denticulate. Animal blind, ctenidial filaments very short, finger-like, osphradium small. Penis large, bent behind head and fused to mid-dorsal line.

Remarks: The new genus appears to be similar to *Beddomena* Iredale, *Tasmaniella* Ancey, *Jardinella* Iredale and Whitley, and *Valvatasma* Iredale, all from Tasmania and closely resembling one another. I have examined the animal of *Tasmaniella launcestonensis* (Johnston) which has the large penis centrally placed behind the head, but there are a number of differences such as well-developed eyes, numerous triangular-shaped gill filaments, and details of the shape of the penis. There are also radula differences. *Potamopyrgus* Stimpson, the only other hydrobiid genus in New Zealand, differs in the species being parthenogenic and in shell morphology. *Opacuincola* is probably derived from the Tasmanian snails, but further discussion should await detailed investigation of the living animals.

Opacuincola caeca n. sp.

Plate 4, figs. 1-4.

Description: Shell small, transparent, rather thin, yellowish, globose, umbilicate. Whorls 3½, strongly convex, rapidly increasing, false margined, smooth except for fine growth lines. Periostracum thin, yellowish. Protoconch smooth, not separated off, whorls convex, slightly depressed. Base convex, with a moderately large umbilical chink opening into a very narrow umbilicus. Aperture oval, slightly oblique, angled distinctly above where it becomes separated from body whorl. Inner lip thickened and distinct from body whorl, concave, columellar portion not distinct, nearly vertical. Outer lip evenly concave, very slightly retracted above, a little more in outer half, but basal portion produced forward slightly. Juveniles have the outer lip rather more strongly retracted. Dead shells opaque white.

Radula moderately long and broad. Central tooth rather large, finely cuspate, the central cusp not enlarged, about 9 serrations on each side; lateral wings distinct, with about 4 denticles on their margins; basal margin convex. Lateral tooth rather short, with parallel sides,

* Dominion Museum, Wellington, New Zealand.

strong, with about 9 moderately large cusps, the third to fifth largest; a strong rib on inner side forms a basal projection which is firmly embedded in the lingual membrane. Marginals long, approximately parallel sided, inner finely denticulate, cutting edge nearly straight; outer a little narrower, cutting edge curved, finely serrate (fig. 4).

Operculum egg-shaped, spiral, slightly concave, thin, transparent, pale yellowish, nucleus a third of total length from right end, about 2½ indistinct spirals, the last very large. Columellar edge convex. No thickening, except a trace below nucleus (fig. 3).

The following details of the animal were taken from one rather poorly preserved specimen. Colour white. Head moderately large, snout short, bilobed. Cephalic tentacles rather long, with slight swellings at their bases but no indication of eyes. Mantle cavity large, ctenidial filaments very short, finger-like, about 10; osphradium very small, oval, simple. Kidney extends into mantle roof posteriorly, large, outer wall glandular, inner thin. Hypobranchial gland not very conspicuous. Rectum long, forming a loop in posterior part of mantle roof, all but the straight anterior portion filled with large, compact, oval faeces. Anus near outer edge of mantle cavity on right side. Buccal mass rather large, oesophagus bent sharply to left. Stomach rather small, containing fine material; style sac short, with a short crystalline style. Digestive gland small. Testis large, vas deferens long and coiled, swollen along nearly all of its length to form a seminal vesicle. Prostate rather short, not extending much into the mantle cavity, swollen, white, split in two by a deep groove, though this appears to be covered by a thin layer of epithelium. Vas deferens enters penis just behind base of right cephalic tentacle. A narrow portion of penis passes back obliquely to a point in the mid line behind the head, this portion being fused to the head. Remainder of penis large and curves round to lie alongside the right cephalic tentacle. There appears to be a retractor muscle attached to the swollen "basal" (i.e. most posterior) portion of the penis, while the free portion tapers to a point at its extremity. About half way along the free portion a short fold opens into a small papilla situated anteriorly on the ventral side (fig. 2).

Holotype: About one mile inside George Creek Cave, East Takaka, Nelson. Collected by Miss B. Elliott. In the Auckland Museum.

Height: 2.24 mm. Diameter: 1.84 mm.

Paratypes: Auckland Museum, Dominion Museum, Wellington.

Remarks: Some of the features of this species, such as the colourless animal and shell, and the lack of eyes, can be attributed to its subterranean habitat, while others, such as the position of the penis are probably phyletic. It would appear as though the penis has moved back from its typical position behind the right eye, to the mid-line of the body behind the head, though the vas deferens enters in the original position.

According to Miss Elliott, *Opacuincola caeca* only lives deep within the George Creek Cave, though empty shells are common washed up along the edges of the George Creek after heavy rain. Deep within the cave they are commonly found alive, about 2-3 under most stones. This is the only undoubted record of a subterranean snail from New Zealand. The solitary specimen of *Potamopyrgus subterranus* Suter is probably a damaged *P. zelandiae* Gray (Dr. R. K. Dell, personal communication), and it appears to be doubtful if any species of *Potamopyrgus* live in truly subterranean conditions in New Zealand, though specimens are occasionally found in pumps and wells. Most of these specimens are probably derived from open water populations, either by regular recruitment or by accidental introduction.

I would like to take this opportunity to thank Miss Elliott for the material she has collected and for the very useful information she has provided.

PLATE 4

Fig. 1. *Opacuincola caeca* n.sp. Holotype.
Fig. 2. *O. caeca* Dorsal view of head showing the penis.
Fig. 3. *O. caeca* Operculum.
Fig. 4. *O. caeca* Radula.

FAMILY TORNIDAE

Genus *COCHLIOLEPIS* Stimpson, 1858.

Type species: *Cochliolepis parasitica* Stimpson, 1858.

Cochliolepis albiceratus n. sp.

Plate 5, figs. 5-8.

Description: Shell minute, discoid, smooth, transparent, widely umbilicate, yellowish white. Protoconch not clearly marked off, nucleus very small, sunken, second whorl bulging above it. Whorls 3¼ convex, false margined, smooth except for growth lines. Base convex, umbilicus broad, the sides convex and smooth. Aperture rounded, peristome sharp, a thin glaze over parietal wall, outer lip strongly and evenly retracted below to give a dorso-ventrally oblique aperture. A very indistinct notch in posterior corner of aperture. Periostracum very thin, pale yellow; aperture white.

Radula very small, rather long. Central tooth comparatively rather large, cusps small, about 4 on either side of the slightly larger median cusp. Lateral regions slightly expanded; middle part of ventral edge convex. Lateral tooth elongate, distal portion expanded, cusps small, about 4 on inner side of main cusp and about 8 on outer side; basal portion thickened and small. Marginal teeth about same length as lateral, inner finely denticulate, outer very finely serrate, slightly narrower than inner (fig. 8).

Operculum circular, thin, closely spiral (about 6 revolutions), transparent, pale yellowish, slightly concave, outer margin very narrowly upturned (fig. 7).

Extended living animal (one specimen) semitransparent white, apart from some orange-red pigment in the dorsal pedal muscles. Foot long, with parallel sides and cleft shallowly behind. Anterior margin of foot rather wide, straight, mobile, but not very extensile, strongly ciliated on lower edge, the propodium dorsally. Sole richly and powerfully ciliated, the cilia beating posteriorly. Sole mucous glands appear to be restricted to lateral parts of foot and extend along the sole from the posterior end to the vicinity of the large, triangular anterior mucous gland. No indication of a posterior pedal mucous gland. Locomotion rapid and appears to be entirely ciliary. Opercular lobes nearly cover the operculum. Snout moderately long, bi-lobed, ciliated ventrally, the cilia beating backwards. Buccal mass large, pinkish orange, visible through the epithelium of the head. Cephalic tentacles long, rather immobile, slender, parallel sided, with slight swellings terminally where a few stiff cilia are visible. A tract of cilia on ventral face of tentacles beat towards outer sides. Eyes large, in slight swellings at base of tentacles. A short posterior pallial tentacle present. No caudal tentacle. A group of white gland cells on inner side of each eye. Internal organs visible through shell. Eggs large; ctenidial filaments well developed, rather close together. Mantle cavity long, extending nearly half way round body whorl (fig. 6).

Holotype: Half way between Pukerua Bay and Paekakariki, on the Wellington West Coast. Under stones in mid-tidal pool containing *Hormosira*, 24/12/61. In the Auckland Museum.

Height: 0.49 mm. Maximum diameter: 1.08 mm.

Paratype: Collected with holotype. In the Dominion Museum, Wellington. The specimen from which the notes on the living animal, radula and operculum were obtained was collected from the same locality as the type series on the 24/1/65. The shell was destroyed. A single specimen was collected at MacGregor's Bay, Whangarei Heads by Mr. K. Hipkins of Auckland.

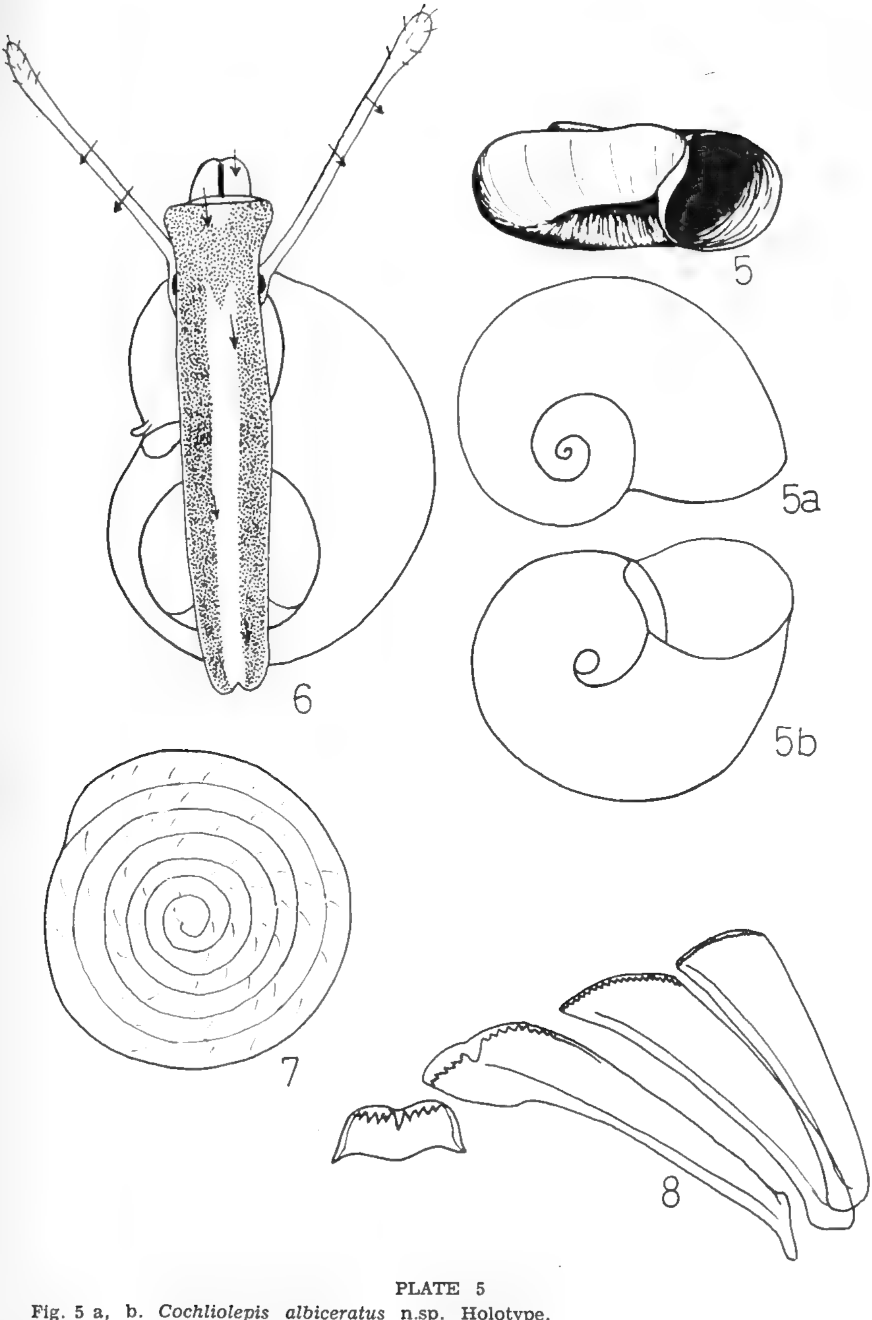


PLATE 5

Fig. 5 a, b. *Cochliolepis albiceratus* n.sp. Holotype.
Fig. 6. *C. albiceratus* Ventral view of living animal. Arrows show ciliary currents and stipple mucous glands.
Fig. 7. *C. albiceratus* Operculum.
Fig. 8. *C. albiceratus* Radula.

Remarks: The Tornidae are poorly known both at the generic and specific level, which makes the correct assignment of a new species to a genus difficult. The placing of the new species in *Cochliolepis* is only tentative, though it is similar to that genus in the possession of simple shell features and sunken protoconch. The genus typically ranges from Virginia to West Florida, some species being known to be associated with other animals. There is only one other tornid described from New Zealand, *Naricava* (*Tropidorbis*) *neozelanica* Powell.

Laseron (1958, *Rec. Aust. Mus.*, 24, p. 176) has included some shells resembling *C. albiceratus* in *Microdiscula* Thiele to which they have no real resemblance. The species in question are *M. involuta* Laseron, *M. planorbis* Laseron, and *M. augmenta* Laseron, and these should probably also be referred to *Cochliolepis* as they are clearly tornids.

CHITON COLLECTING AT PORT GAWLER, SOUTH AUSTRALIA

By K. L. MILNE*

Messrs. George Buick, Max Tilbook and the author went on an expedition to Port Gawler, South Australia, for the purpose of checking the statement of Cotton and Godfrey (1940) *The Molluscs of South Australia*, Part II, p. 469, that chitons may be found, among other stations, ". . . amongst the roots of mangroves . . ." Also on p. 527, referring to *Acanthochiton bednalli*, "The species seems to prefer shallow water and muddy places and is often plentiful near mangrove swamps and similar situations."

One species identified as a variation of *Acanthochiton bednalli* (Pilsbry) was found in considerable numbers. Over 100 specimens were taken between the three of us in about 1½ hours, once their habitat was located. They were found in the mangrove swamps, at Port Gawler, at the southern end of the bay, about 30 to 50 yards inland from the outer edge of the line of trees, at low tide.

They were mostly found on the pneumatophores of the mangroves just above or just below the sand-mud. A few specimens were found on drift deposited bubble weed and old bits of sea-weed. Several large specimens were also found on the underside of old branches or pieces of wood half submerged at low tide. Those on pneumatophores could be found either by pulling up the penumatophores or merely by removing the bubble weed and bending the pneumatophores so that the part below the sandy mud was visible, thus exposing the chitons, if present.

The large older specimens were usually found just above the sand-mud, while the juveniles and smaller specimens were nearly always below it.

The interesting point is that, as far as we know, this is the only known instance of chitons having been found living on a substance other than rocks or living sea-weed in South Australia. It was surprising to us to find them living on old submerged or partly submerged boughs and pieces of cut wood. This was apparently a preferred habitat for them, because in two instances there were three large specimens on such pieces of wood. Specimens were taken from mangrove roots some years ago by the late B. C. Cotton, but to our knowledge no precise details of the habitat were given.

* 14 Burlington Street, Walkerville, South Australia.

A RECLASSIFICATION OF SOME RISSOACEA FROM THE WESTERN PACIFIC

By JACQUES VOORWINDE*

Before attempting to reclassify the material under consideration, it is well to state the following. From personal knowledge it can be said that Laseron's admirable work on rissoids (1950, 1956), was greatly hampered by: (1) inadequate and sometimes imperfect material; (2) difficulty of access to museum collections, library and records; (3) a quite insufficient light source for such delicate work and inadequate magnification with a low powered dissecting microscope, resulting at times in misinterpretation of protoconchs and scultpure.

Notwithstanding these adverse circumstances, his pioneering work will for many years to come, form the basis upon which future knowledge of this difficult group will be built. Other workers, especially anatomists, cytologists and other students of the living animals will undoubtedly reach and publish different conclusions and more refined definitions. At the present time a reclassification of the group on shell characters seems necessary, based upon a clearer insight through the greatly extended collections now at hand.

The main division of the superfamily Rissoacea into Rissoidae and Rissoinidae seems no longer tenable. Instead the superfamily Rissoacea is here divided into a number of families which in the future probably will increase in number, as a result of the need for more precise and more logical classification. Whereas other superfamilies and families are reasonably well defined, there is as yet no agreement as to what groups must be included under the Rissoacea, as the relationship between this and other groups, especially brackish and freshwater forms, is not at all clear. Anatomical study together with a better insight into ecology, and geographic distribution must eventually lead to better understanding. In this regard important studies are now being undertaken by Mr. Winston Ponder of New Zealand, to whom I am indebted for many helpful suggestions and unpublished data.

Attempts at reclassification based on insufficient knowledge of local genera (e.g. that of Coan, 1963) add little to our knowledge but instead contribute to the all too prevalent confusion. Many genera are now grouped together in numerous families e.g. Rissoidae H. A. Adams, 1854; Rissolinidae Gould, 1861; Rissoinidae Stoliczka, 1868; Orbitestellidae Iredale, 1917; Barleeidae Thiele, 1929; Dialidae Iredale and McMichael, 1962; Obtortionidae Iredale and McMichael, 1962; Phosinellidae Coan, 1964; Eatoniellidae Ponder, 1965; Amphithalamidae Ponder, 1965. The general tendency at present seems to be to extend the number of families in this very complex and diverse superfamily, with a consequent curtailment of the number of genera within each family, a method which seems to be supported by the latest anatomical evidence. In the meantime, study at the specific level continues and one may hope that in the not too distant future, a much clearer picture may emerge.

I wish to thank Dr. D. F. McMichael for the interest shown in the compilation of this work and for his advice and encouragement to publish the results reached after many years of intensive study.

* Honorary Associate, The Australian Museum, Sydney.

FAMILY RISSOLINIDAE GOULD, 1861

Genera: *Rissolina* s.s. Gould, 1861; *Costalynia* Laseron, 1956; *Fractoralla* Laseron, 1956; *Schwartziella* Nevill, 1881; and *Pandalosia* Laseron, 1956.

Remarks: *Costalynia* was separated by Laseron from *Rissolina* Gould (Laseron, 1956, p. 395) solely on the basis of the supposed absence of spirally incised lines, a distinction which would hardly justify generic differentiation even if true. Reasonable magnification of well preserved material however shows that all Australian species attributed to *Costalynia*, including the type species have spirally incised lines, though these may be only faintly visible on the lower part of the body whorl. *Costalynia* is therefore a synonym of *Rissolina* Gould.

The tendency of many rissoaceans to discard their protoconchs and often the early teleoconch whorls also, together with the formation of a protoconch-like plug has not always been fully recognised in this group. Laseron considered it as a feature for specific or even generic differentiation. This throwing off, or reabsorption of the protoconch often occurs in those shells where the texture of the protoconch and that of the adult shell is very different. Further evidence of the later formation of the plug is shown by the different texture of the shelly matter of the plug which is of a calcareous nature and does not contain conchiolin as does the protoconch. Protoconchs in Rissoacea, and in most other grastropods for that matter are almost entirely formed by conchiolin in the first instance which is later strengthened and thickened by calcareous inclusions. The visceral hump, being unable to produce conchiolin can only repair the protoconch scar with calcium carbonate. The calcareous composition of the plug is always quite evident and can be clearly distinguished from the true protoconch. This disposal of the protoconch may be explained in the following way; when the animal's visceral hump no longer occupies the entire length of the spire there will be a tendency to reabsorb, or throw off, or shelve off, that portion which is of no further use. Throwing off or reabsorption of protoconchs and earlier whorls is evident in many Rissoacea and related families such as the Truncatellidae. Very extensive reabsorbtion of shelly matter is found for example in the Ellobiidae (see Crosse and Fischer, 1882, and Moreton, 1955) in which the whole of the upper part of the columella and the internal parts of the upper whorls are reabsorbed. Terebrids, thiarids, vermetids and cerithiids use other measures and may form septa closing off the earlier part of the shell, without discarding it.

Disposal of the protoconch occurs frequently in the Rissolinidae and should never be taken as an argument for either specific or generic differentiation. For this and other reasons outlined above, *Costalynia* is considered a synonym of *Rissolina* while on the specific level, *Costalynia* (= *Rissolina*) *decapitata* Laseron, and *C. truncata* Laseron must be considered conspecific.

Apertural developments similar to those found in *Schwartziella* (see below) are prevalent in *Rissolina*. The heavier armament of the aperture and the development of the "pseudocanal" as Laseron calls it, is wholly due to the greater maturity of the shell. Even in the New South Wales species *R. angasi*, and more obviously in *R. crassa* where the apertural characteristics are less well developed than in related Queensland species, one finds fully mature specimens showing this pseudocanal clearly. To distinguish *Fractoralla* from *Rissolina* on these nebulous grounds seems inadvisable and thus *Fractoralla* is here considered a full synonym of *Rissolina*.

The two principal features used by Laseron to distinguish *Pandalosia* from *Schwartziella* were the protoconch and the apertural varix, all other features being similar (the relative sizes of the body whorl and the

penultimate whorl are always proportional to overall dimensions). In *Schwartziella* the number of protoconch whorls was given as 1½ but both *S. inconspicua* (Brazier) and *S. lata* Laseron have a protoconch of 2½ whorls as have *Pandalosia excelsis* Laseron and *P. darwinensis* Laseron. Only *Pandalosia obtusa* Laseron has a protoconch of 1½ whorls. Clearly, the number of whorls in the protoconch is inadmissible as a character to separate the two genera. Many genera of Rissoacea show marked differences between what can be regarded as newly mature shells and old mature shells (the latter of course less often encountered). These have been used by Laseron as a point of difference between *Schwartziella* and *Pandalosia*. Close study of many specimens of all related species reveals that *Schwartziella* develops in advanced mature age apertural characters identical with those assigned to *Pandalosia*. Even Laseron's figures illustrate this point (compare fig. 2 and fig. 3 of Laseron, 1956). As there is no correlation between apertural features and the number of protoconch whorls it must be concluded that *Pandalosia* is a synonym of *Schwartziella* with the species *obtusa* Laseron a synonym of *inconspicua* (Brazier). The species *delicatula* Laseron is neither a *Pandalosia* nor a *Schwartziella* but belongs in *Austrosina* (= *Rissoina*).

FAMILY RISSOINIDAE STOLICZKA, 1868.

Genera: *Rissoina* d'Orbigny, 1840; *Peripetella* Laseron, 1956; *Moerchiella* Nevill, 1855; *Zymalata* Laseron, 1956; *Zebinella* Mőrch, 1876; *Condylicia* Laseron, 1956; *Austrosina* Laseron, 1956; *Apataxia* Laseron, 1956; *Pleneconea* Laseron, 1956.

Remarks: If, within a family, so many species occur that the group becomes unmanageable (as in *Marginella* for example) genera are created to facilitate easier determination. In my opinion these genera should only be made of groups of species which are clearly distinguishable from other such groups within the family by at least more than one clearly defined and recognisable feature. Subdividing a genus as Laseron did with *Rissoina* s. lat. into *Peripetella, Moerchiella* etc., is fraught with danger and makes naming shells of this group extremely confusing. *Rissoina inca* d'Orbigny, 1846, the type species of *Rissoina*, has pronounced axial ribs on nearly all the later whorls. In Australian species belonging to this genus, there is a tendency for this sculptural character to vary from a few, bold axial ribs to a large number of fine ribs which tend to be less well developed on the earlier whorls but more so on the later whorls. In some cases (as in *Moerchiella*) the axial ribs are more or less visible only on the earlier whorls and disappear on the later whorls. The drawing of lines of demarkation between genera in such cases is purely subjective and is here considered inadvisable.

If the group of Australian shells called *Zymalata* by Laseron is to be recognised as a separate genus (the generic description hardly justifies this) it can not be called *Zymalata* as there is a perfectly good genus erected for similar species in *Zebinella* Mőrch, 1875. *Condylicia* is also a synonym of *Zebinella*. The supposed difference between them i.e., "finely incised striae" instead of "raised threads" is a question of interpretation and degree. Until more of the animal is known and better specimens are compared, fine differences in texture of this nature must be considered not of sufficient importance to serve as a basis for generic differentiation. The aperture of *Condylicia* also shows no difference from that of *Zebinella* as Laseron's figures clearly illustrate.

Moerchiella could be defended on the basis of its size, "twice as big as *Peripetella*" (which statement is however, an over simplification), and the thin shell and diminishing sculpture. All other features are found in all other members of *Rissoina* s.l. How difficult it is to assign most species either to *Peripetella* or *Moerchiella* is shown by the confusion

of Laseron himself and subsequent writers who, rather arbitrarily included species in first one genus, then another. *Rissoina fasciata* A. Adams (Laseron, 1950, p. 261) has little in common with *Moerchiella*, the genus in which Iredale and McMichael (1962) classified it, but answers completely the description of *Rissoina* s. str., while *usitata* Laseron does not fit in the generic description of *Moerchiella* at all and may be a new genus located somewhere near *Caporista* Iredale. Close study seems to indicate the following logical arrangement although further anatomical study may prove otherwise: *Peripetella* to be used only for *queenslandica* Laseron and *linearis* Laseron; *immersa* Laseron = *queenslandica* Laseron. *Zymalata* Laseron = *Zebinella* Mőrch. *Moerchiella* Nevill only to be applied to large, thin Rissoid shells from the western Pacific. The New South Wales species *Moerchiella fasciata* (A. Adams) and *Peripetella variegata* (Angas) are to be left in *Rissoina* s. str.

Austrosina Laseron, 1956, agrees completely with *Rissoina s.s.* as here interpreted, its very apparent relationship with the New South Wales species *fasciata* and *variegata* illustrating this point. The only differences between these shells and the Queensland species described as *Austrosina* are the slightly stronger axial ribs, which as stated before are not a suitable basis for objective separation of genera; in all other features they are typical of *Rissoina*. Discussing and describing *Austrosina* within the context of the Rissolinidae as Laseron did is not only inexplicable, but confusing and has lead to faulty conclusions. When studied closely, the generic description of *Austrosina* differs in no way from that of *Rissoina*, except in the protoconch which is described as "conical, smooth, 3 whorls." However a number of Rissoinas have a 3 whorled, smooth, conical protoconch and it is only the comparision with the type species *inca* d'Orbigny coupled with complete disregard of other known species of *Rissoina* s.s., that led him to this false conclusion. At the specific level, only mature specimens of *Rissoina* develop the fine spiral threads on the lower half of the body whorl. More extensive material now available shows that both *quinita* Laseron and *evanida* Laseron are conspecific with *pulchella* Brazier; *evanida* Laseron was described from a single aberrant broader specimen, well within the variation of the species.

Apataxia Laseron, 1956, seems to be a valid genus, coming very close to *Rissoina s.s.* but with very regular, sharp sculpture, the spiral incisions overriding the axial ribs and more clearly defined than in *Rissoina* s.s.

Pleneconea Laseron, 1956, has large, heavy shells which show close affinity with *Rissoina*, but the angulated body whorl with the resulting triangular aperture sets it sufficiently apart to justify generic separation. The reflected thick aperture and strong varix, representing advanced maturity, were emphasised by Laseron when describing the genus. However as discussed above, these features are found in other rissoinid genera.

FAMILY PHOSINELLIDAE COAN, 1964

Genera: *Phosinella* s. str. Mőrch, 1876; *Phintorene* Iredale, 1955; *Planapexia* Laseron, 1956; *Merelina* Iredale, 1915; *Isseliella* Weinkauff, 1884.

Remarks: In his justification of Iredale's genus *Phintorene*, Laseron states (1956, p. 405) "there is no fundamental difference between *Phosinella* and *Phintorene* except the size, the former being 8 mm. or more, the latter 6 mm. or less." That this hardly justifies generic separation is obvious, making *Phintorene* a synonym of *Phosinella*, there being no other characters to distinguish them. As explained above many Rissoacea are subject to disposal of the protoconch and early whorls, replacing them by a protoconch-like plug, and considerable changes may occur in apertural characters in advanced mature age. Both features are very

pronounced in some species of *Phosinella* and thus, there is no valid justification for the retention of *Planapexia* which was differentiated on these misinterpreted features. *Planapexia* Laseron therefore is clearly a synonym of *Phosinella* Mőrch.

Species allocated to *Isseliella* Weinkauff have certain features which serve for generic separation and they form a rather well defined group. Their predominantly rounded whorls, much finer sculpture, of rounded, ill-defined, rather than sharp clathrations, and the absence of a tuberculate fold on the body whorl, possessing instead a smooth basal fold, distinguish them from *Phosinella* Mőrch.

The sculpture of *Merelina,* its general shell outline, and its apertural features, which resemble those of immature *Phosinella,* indicate a close relationship with *Phosinella.* However there are sufficient differences to warrant its retention as a full genus. Groups closely related to *Merelina* which could be treated provisionally as subgenera are *Pyramidelloides* Nevill, 1855 (*P. viticula* Laseron is however a *Costabieta*); *Costabieta* Laseron, 1956; *Herewardia* Iredale, 1955. I have found the sculpture on the lower part of the body whorl not only of the greatest importance in recognising specific differences but also in assessing the relationship between genera. The number, texture and character of the basal folds are the only non-variable characters found in species of *Merelina,* all others e.g. size, shape, texture, sculpture, being variable to a greater or lesser extent.

SUMMARY

PROPOSED CHANGES IN THE NOMENCLATURE OF SOME WESTERN PACIFIC RISSOACEA

Family Rissolinidae Gould, 1861.

- Genus *Risssolina* Gould, 1861 (*Rissoina plicatula* Gould, 1861, subs. des. Nevill, 1885).
    - Syn. *Costalynia* Laseron, 1956 (*Rissoina cardinalis* Brazier, 1877, orig. des.).
    - Syn. *Fractoralla* Laseron, 1956 (*F. praecida* Laseron, 1956, orig. des.).
- Genus *Schwartziella* Nevill, 1881 (*Rissoina orientalis* Nevill, 1881, orig. des.).
    - Syn. *Pandalosia* Laseron, 1956 (*P. excelsis* Laseron, 1956, orig. des.).

Family Rissoinidae Stoliczka, 1868, nom. trans. Cossman, 1919 (ex Rissoininae).

- Genus *Rissoina* s. str. d'Orbigny, 1840 (*R. inca* d'Orbigny, 1840, monotypy).
    - Syn. *Austrosina* Laseron, 1956 (*A. pulchella* Brazier, 1877, orig. des.).
- Genus *Moerchiella* Nevill, 1884 (*Rissoa gigantea* Deshayes, 1863, orig. des.).
- Genus *Zebinella* Mőrch, 1876 (*Helix* = *Rissoina decussata* Montagu, 1803, sub. des. Nevill, 1885).
    - Syn. *Zymalata* Laseron, 1956 (*Z. concinna* Laseron, 1956, orig. des.).
- Genus *Apataxia* Laseron, 1956 (*A. erecta* Laseron, 1956, orig. des.).
- Genus *Peripetella* Laseron, 1956 (*P. queenslandica* Laseron, 1956, orig. des.).
- Genus *Pleneconea* Laseron, 1956 (*P. angulata* Laseron, 1956, orig. des.).

Family Phosinellidae Coan, 1964

Genus *Phosinella* s. str. Morch, 1876. (*Rissoa pulchra* C. B. Adams, 1850, subs. des. Nevill, 1884).
Syn. *Phintorene* Iredale, 1955 (*Rissoina allanae* Laseron, 1950, orig. des.).
Syn. *Planapexia* Laseron, 1956 (*P. fractura* Laseron, 1956, orig. des.).

Genus *Isseliella* Weinkauff, 1881 (*Rissoina* (*I.*) *mirabilis* Weinkauff, 1881, orig. des.).

Genus *Merelina* Iredale, 1915 (*Rissoina cheilostoma* T. Woods, 1877, orig. des.).

Subgenus *Pyramidelloides* Nevill, 1884 (*Rissoina miranda* A. Adams, 1861.

Subgenus *Herewardia* Iredale, 1955, (*Rissoa kesteveni* Hedley, 1907, orig. des.).

Subgenus *Costabieta* Laseron, 1956 (*C. paucina* Laseron, 1956, orig. des.).

REFERENCES

COAN, E., 1964. A Proposed Revision of the Rissoacean Families Rissoidae, Rissoinidae, and Cingulopsidae. *Veliger,* 6, pp. 164-171, fig. 1.

CROSSE, H., and FISCHER, P., 1882. Note complémentaire sur la résorption des parois internes du test, chez les *Auriculidae. J. Conchyliol.,* 30, p. 177-181.

FRETTER, V., and GRAHAM, A., 1962. *British Prosobranch Molluscs.* Ray Society, London.

IREDALE, T., and McMICHAEL, D. F., 1962. A Reference List of the Marine Mollusca of New South Wales. *Mem. Aust. Mus.,* 11, pp. 39-43.

LASERON, C. F., 1950. Review of the Rissoidae of New South Wales. *Rec. Aust. Mus.,* 22, pp. 257-287, figs. 1-94.

LASERON, C. F., 1956. The families Rissoinidae and Rissoidae (Mollusca) from the Solanderian and Dampierian Zoogeographical Provinces. *Aust. J. Mar. Freshw. Res.,* 7, pp. 384-484, figs. 1-228.

MORTON, J. E., 1955. The functional morphology of the British Ellobiidae (Gastropoda pulmonata) with special reference to the digestive and reproductive systems. *Phil. Trans.* B, 239, pp. 89-160.

THIELE, J., 1929. *Handbuch der systematischen Weichtierkunde.* Gustav Fischer, Jena. Teil 1, pp. 136-180.

WENZ, W., 1939. Gastropoda. *Handbuch der Paläozoologie* (*Schindewolf*) 6, (1), pp. 554-650.

A NOTE ON *SPHAERIUM LENTICULA* DUNKER

by J. G. J. KUIPER*

Text figs. 1-3.

Sphaerium lenticula Dunker (1862: 153) was described from specimens collected in lakes Rotoiti and Taupo, New Zealand. Because the description lacked accompanying figures, its identity has remained somewhat enigmatic. Owing to its small size, Hutton (1881, 1883) and Hedley and Suter (1892) regarded it as a distinct species of the genus *Pisidium* C. Pfeiffer. In my revision of the New Zealand sphaeriids (Kuiper, 1966: 152) I placed *Sphaerium lenticula* in the synonymy of *Sphaerium* (*Sphaerinova*) *novaezelandiae* Deshayes, 1854, on the basis of Dunker's diagnosis only.

Through the courtesy of Dr. R. Kilias, Zoological Museum of the Humboldt University, Berlin, I have been able to study the type lot of *Sphaerium lenticula* from Lake Rotoiti, which is preserved in the Dunker Collection. It contains five specimens which indeed all proved to be juveniles of *Sphaerium novaezelandiae*. Their dimensions are as follows:

1.	L 3.9 mm	H 3.5 mm	D 2.0 mm	(figs. 1, 2)
2.	L 3.7 mm	H 3.3 mm	D 2.0 mm	(fig. 3)
3.	L 3.7 mm	H 3.3 mm	D 1.9 mm	
4.	L 3.6 mm	H 3.1 mm	D 1.9 mm	
5.	L 3.2 mm	H 2.9 mm	D 1.7 mm	

I designate the largest specimen, (No. 1 above) as Lectotype. Its shell is rounded-oval, thin, translucent, fragile; the beaks are flattened, scarcely raised, slightly prosogyrous, median, smooth; the surface is glossy, faintly striate. The ligament is visible exteriorly. The hinge-plate is weak, the main laterals are long, and narrow, the cardinals short and straight; the distance between the cusps of the posterior laterals and the cardinals is twice that between the anterior laterals and the cardinals. Under high magnification (70 x) numerous pores are visible in the shell.

Mr. H. Jungen, of the Zoological Museum of the University of Zűrich, kindly allowed me to examine 2½ specimens preserved in the A. Mousson collection. Like the Berlin specimens they are labelled *Sphaerium lenticula* by Dunker and were also collected in Lake Rotoiti. They too are young *Sphaerium novaezelandiae*. The largest specimen in this series measures L 4.0 mm, H 3.6 mm, D 2.1 mm.

REFERENCES

DESHAYES, G. P., 1854. Description of new shells from the collection of Hugh Cuming Esq. *Proc. Zool. Soc. Lond.*, 22: 317-371.

DUNKER, W., 1862. Beschreibung einiger von Herrn Dr. v Hochstetter auf Neuseeland gesammelten Sűsswasser Mollusken. *Malak. Blätt.* 8: 150-154.

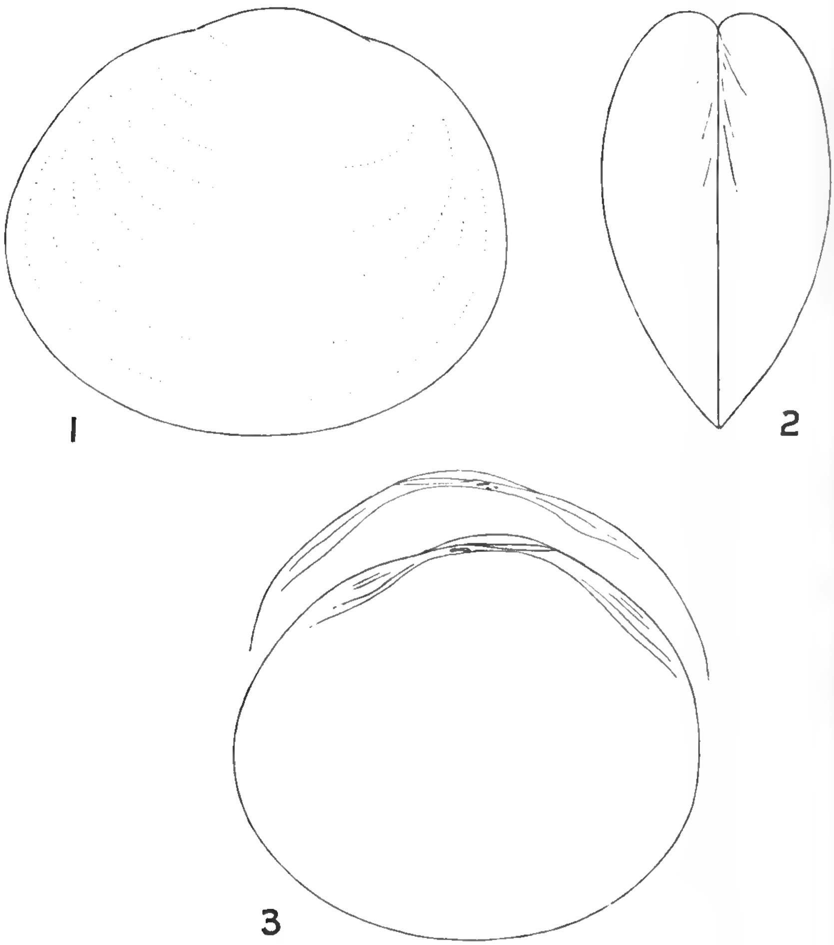
HEDLEY, C., and SUTER, H., 1892. Reference list of the land and freshwater Mollusca of New Zealand. *Proc. Linn. Soc. N.S.W.* 7: 664.

HUTTON, F. W., 1881. On the fresh-water Lamellibranchs of New Zealand. *Trans. Proc. N.Z. Inst.*, 14: 148-150.

————, 1883. List of the freshwater shells of New Zealand. *Proc. Linn. Soc. N.S.W.*, 7: 67-68.

KUIPER, J. G. J., 1966. Critical Revision of the New Zealand Sphaeriid clams in the Dominion Museum, Wellington. *Dom. Mus. Rec. Zool., Wellington,* 5: 147-162, figs. 1-27.

* Institut Neerlandais, 121 Rue de Lille, Paris 7e, France.



Figures 1-3. *Sphaerium lenticula* Dunker. Fig. 1. Lectotype, outside right valve. Fig. 2. Lectotype, profile view. Fig. 3. Innerside of one of the paralectotypes, left valve on top. Magnification x 16 approx.

A BRIEF ACCOUNT OF THE SPAWN OF *CONUBER INCEI* (PHILIPPI, 1853) (GASTROPODA : NATICIDAE)

By FLORENCE V. MURRAY*

Pls. 6, 7.

SUMMARY

C. incei releases an egg mass which differs essentially from the classical sand-collar spawn of the naticids in being sand-free. The larvae hatch as free-swimming planktotrophic veligers.

Genus *CONUBER* Finlay and Marwick

Conuber Finlay and Marwick, 1937, *Palaeont. Bull. N.Z.* 15: 53.

Conuber incei (Philippi)

Natica incei Philippi, 1853, *Proc. Zool. Soc. Lond.,* 1851: 233.

INTRODUCTION

The presence of sand grains is characteristic of naticid spawn, which, typically, is a collar-shaped, sand-encrusted, gelatinous ribbon, but in 1962 it was found that three species, *Conuber conicum* (Lamarck, 1822), *C. sordidum* (Swainson, 1821) and *C. melastoma* (Swainson, 1822), produced voluminous, gelatinous egg masses free of sand (Murray, 1962), and this suggested an investigation into the spawning behaviour of *Conuber incei,* a species inhabiting ocean beaches and ranging throughout Australia generally, with the exception of Tasmania. (Pl. 6, fig. 1).

BREEDING HABITS

The experiment was carried out with specimens from the sheltered ocean beach at Waratah Bay on Wilson's Promontory in southern Victoria. There, in November 1962, at low tide, on the extensive sandy inter-tidal area the snails were surfacing in abundance, both juveniles in various stages of growth and adults reaching up to 28 mm. in length. Mating pairs were located at the ends of trails in the sand and five of these, of medium size, were selected and transferred to a two-gallon aquarium with a substratum of sand from their habitat. Pairing also took place in the aquarium. In all cases observed the male was the smaller of the two and clung tenaciously to the back of the shell of its partner in such a position as to allow its penis to pass down over the edge of the outer lip of the female shell aperture and then to turn upwards into the mantle cavity; at the same time the anterior reflexion of the propodium, inflated laterally, afforded protection from sand etc. Pairs were noted to remain in union for several hours and were not easily separated: if disturbed, the female would push down into the sand without unsettling or interrupting the male.

Egg collars were released from December through to March. Possibly spawning would begin before December; although the experiment was repeated in 1963 and 1964 the collection of material at an earlier date in either year proved personally impracticable. No collars were found in the field but only a few searches were made and their size and nature would make them difficult to see.

* 13 Gaynor Court, Malvern, Victoria.

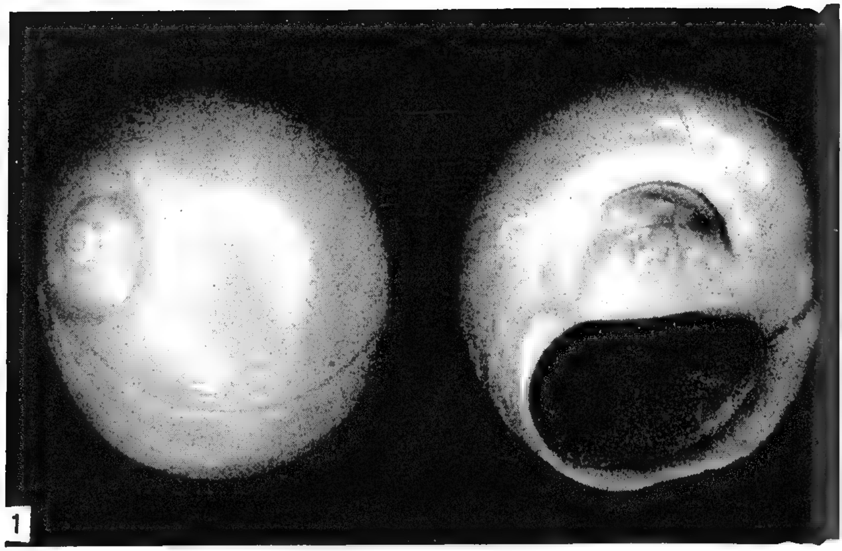


PLATE 6.

1. *Conuber incei* (Philippi). Shells: 29 x 24 x 15 mm.

2. *Conuber incei* (Philippi). Gelatinous egg collar.
Basal length 45 mm; height 13 mm.

FOOD

The snails were constantly supplied with the small Wedge Shell, *Donacilla nitida* (Deshayes), which they bored and sucked voraciously, preferring them to other bivalves offered.

THE SPAWN

(Pl. 6, fig. 2)

The egg mass is a firm, flexible, gelatinous ribbon in the form of an incomplete annulus: its wall is concave on the outer and convex on the inner face; several layers of egg capsules are contained within the matrix, except at the margins, which are acapsular; the apical margin tends to thicken, while the basal margin tapers away to a thin edge on which the ribbon rests in its natural position: the whole is invested with a thin, transparent integument.

In size, the collars varied considerably (basal length from 25-50 mm., width (height) 8-13 mm., thickness 1.3-2.5 mm.); these were produced by parents with shells averaging 20 x 16 x 9 mm. in length, width and height: larger parents presumably would release larger egg masses.

Specimens have been deposited in the National Museum of Victoria, Melbourne (reg. no. F 26386).

THE EGG CAPSULES

(Pl. 7)

The eggs are yellow, spherical and average 0.25 mm. in diameter; each is covered by a vitelline membrane and is contained within an elastic

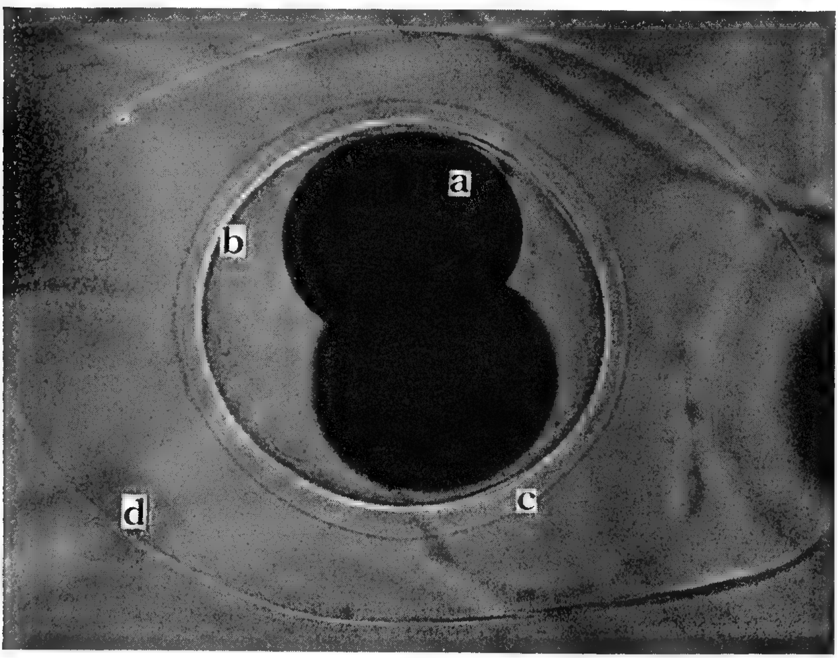


PLATE 7.

Conuber incei (Philippi). Egg. capsule.
a = egg in cleavage, b = egg envelope,
c = envelope covering, d = outer capsule.
Photomicrograph x 112

envelope which in turn is suspended in a larger or outer capsule. The envelope is invested with a membranous covering and is spherical with an average diameter of 0.35 mm.: it enlarges as the embryo develops and prior to hatching, when it ruptures, it almost fills the outer capsule which is oval averaging 0.75 x 0.50 mm. These capsules are closely packed within the matrix of the ribbon, and being dovetailed into each other may be irregularly shaped.

As the mass ripens the integument sloughs away in fragments, and the gelatinous matrix slowly dissolves allowing the veligers, which have escaped from the ruptured capsules into the jelly, to enter the water. Dissolution begins in 10-14 days according to the temperature.

DEVELOPMENT

Spawning takes place beneath the sand and in one collar, which was examined as soon as it had been pushed to the surface, the eggs at the initial end of the ribbon were beginning to cleave. The first two cleavages are equal and are achieved within a few hours at a water temperature of 21°C: subsequent cleavages result in the formation of large macromeres and small micromeres which spread rapidly over the former giving rise to a blastula within 12 hours. A flattening at the animal and vegetative poles leads on to gastrulation during the next 12 hours and the trochophore stage is reached within 48 hours. Subsequent development follows, in general, the pattern outlined for other *Conuber* species in a previous paper (Murray, 1962).

The veligers have large, almost rectangular velum lobes heavily pigmented with purple at the borders. Their shells are colourless, consist of about one whorl and average 0.425 mm. across at hatching.

ACKNOWLEDGEMENTS

I am sincerely grateful to many friends who helped with the collection and transport of material; to my sister, Miss Margery Murray, for assistance in maintaining the aquaria; and to Mr. J. E. Peterson and Mr. A. M. Rowlatt of the C.S.I.R.O. Animal Health Research Laboratory, for the photographs of Plate 6 and the photomicrograph of Plate 7.

REFERENCES

GIGLIOLI, M. E. C., 1955. The egg masses of the Naticidae (Gastropoda). *J. Fish. Res. Bd Canada,* 12: 287-327, figs. 1-14.

MURRAY, F. V., 1962. Notes on the spawn and early life history of two species of *Conuber* Finlay & Marwick, 1937 (Naticidae). *J. Malac. Soc. Aust.,* 6:49-58, pls. 6-9.

JOURNAL OF THE
MALACOLOGICAL SOCIETY
OF AUSTRALIA

Volume 1

Numbers 11 - 12

SYDNEY AND GEELONG

1968 - 1969

The JOURNAL OF THE MALACOLOGICAL SOCIETY of AUSTRALIA is an annual publication for authoratative scientific papers dealing with Mollusca and related topics.

Acceptance of papers for the *Journal* is in the hands of the Editorial Board of the Malacological Society of Australia. All enquiries and manuscripts should be forwarded to the Editor, Mr. Robert Burn, 3 Nantes Street, Newtown, Geelong, Victoria, 3220.

Instructions to authors for the *Journal* are available upon request.

TABLE OF CONTENTS

JOURNAL No. 11 (22 March 1968)

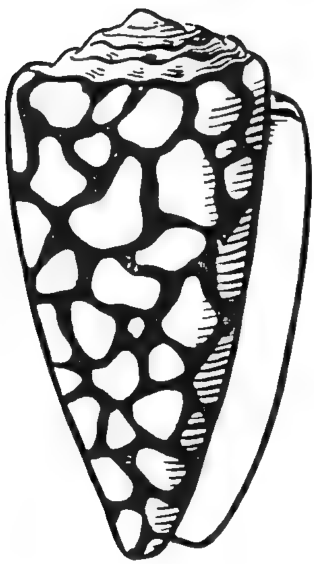
JOURNAL No. 12 (22 March 1969)

NEW TAXA DESCRIBED IN

VOLUME 1, Nos. 11 - 12

JOURNAL OF THE MALACOLOGICAL SOCIETY OF AUSTRALIA

No. 11



Published March 22nd, 1968.

THE MALACOLOGICAL SOCIETY OF AUSTRALIA

1967

Patrons:

R. TUCKER ABBOTT, Ph.D.
E. ALISON KAY, Ph.D.

Honorary Members:

A. W. B. POWELL, D.Sc.
RUDOLF BRUNNSCHWEILER, Ph.D.
EDMUND D. GILL, B.A., B.D., F.G.S.
P. H. FISCHER
BRIAN SMITH, B.Sc., Ph.D.

Honorary Life Member:

Mrs. THELMA HARTLEY

President:

T. A. GARRARD

Hon. Secretary-Treasurer:

DONALD F. McMICHAEL

Hon. Editor:

DONALD F. McMICHAEL

Printed by SURREY BEATTY & SONS, Rickard Road, Chipping Norton, N.S.W. Registered in Australia for transmission by post as a book.

Published annually by the Malacological Society of Australia and obtainable from the Hon. Editor, C/o The Australian Museum, College Street, Sydney, N.S.W. Price $2.00 Australian, or $2.25 U.S. Currency, or 19/- Sterling. Special rates for complete sets.

OBITUARY — J. A. (TONY) MARSH

Malacologists and shell collectors throughout the world will be shocked and saddened to learn of the death in Brisbane, Queensland, on December 16th, 1967, of James Anthony Marsh, known affectionately to all as Tony, following a brief illness. Not long before he had been actively associated with the First Australian Shell Collectors' Convention held at Yeppoon, Queensland, jointly sponsored by the Keppel Bay Shell Club, of which he was patron, and this Society; and it is difficult to realise that so vigorous and vital a person is no longer with us.

Born in Weymouth, Dorset, on May 8th, 1913, he moved with his parents to Australia in 1927, and married Elsie Coates of Rockhampton, Queensland in 1939. His career was varied: he learned to fly and took part in the Brisbane to Adelaide air race for the Adelaide Centenary celebrations in 1936, and later became an instructor for the Royal Queensland Aero Club in Brisbane, Rockhampton and Mackay, and subsequently trained pilots during World War II. He was a farmer for some years, and eventually settled in Rockhampton in 1954 where he founded a successful motor engineering business.

Tony's interest in shells began about 1951 and he soon became a serious collector whose natural ability led him to study the taxonomy of cone shells, in which he quickly became expert. He amassed a collection of *Conus* which was certainly without equal in Australia, much of it collected personally, though he also exchanged with collectors throughout the world and he carried on a large correspondence. His knowledge of the group was such that many collectors and professional malacologists referred material to him for identification or opinion.

He published two items of importance in malacology: a paper entitled "Two new cone shells (Mollusca, Conidae) from Queensland" in this *Journal*, No. 6, pp. 40-42, pl. 4 (January, 1963) in which he described *Conus* (*Leptoconus*) *sculletti* and *Conus* (*Leptoconus*) *nielsenae;* and a book entitled *"Cone Shells of the World"*, illustrated by O. H. Rippingdale (Jacaranda Press, Brisbane, 1964, 166 pp., 22 plates) in which his views on *Conus* nomenclature are set out in full. It has proved to be a valuable aid in classifying this difficult group and will always stand as a memorial to him. Besides these two works he edited and contributed a number of articles to the magazine "Keppel Bay Tidings" published by the Keppell Bay Shell Club in recent years.

More than anything else Tony Marsh will be remembered for his kindly nature and hospitality. His home was always open to collectors and many hundreds of visitors to Rockhampton from all corners of the world will remember with pleasure the time spent in company with Tony and his family. Beside his shells, he loved music, books, good food and wine, nature, people—in fact he loved life. He is survived by his widow and five children, to whom we extend our deepest sympathy.

—Donald F. McMichael

A NEW SPECIES OF *LATIAXIS* (GASTROPODA: MAGILIDAE) FROM QUEENSLAND, AUSTRALIA

By ANTHONY D'ATTILIO*

Plate 1

Through the generosity of Mr. T. A. Garrard of Dundas, New South Wales, I am privileged to describe this new species of *Latiaxis* from southern Queensland.

Only a few species of this interesting family have been thus far discovered on the eastern coast of Australia. During the last few years the presence of two species known hitherto only from Japanese waters have been found to occur also off the shores of Australia (McMichael, 1961).

The decision to describe a new species of this group was made difficult due to the fact that only two specimens were available to me for study. A photograph of a third specimen in private hands was kindly lent to me through Mr. Garrard's efforts. Apparently in spite of inquiries to various sources, no other specimens are known to exist in private or institutional collections at the present time.

Latiaxis (*Pseudomurex*) *garrardi* n.sp.

Plate 1, top four figures

Description: Shell medium in size, scabrous, of coarse solid growth, with an exserted spire, height 37.5 mm., aperture to end of canal 20 mm. Whorls 7, spire shouldered, body whorl shouldered and becoming convex below. Color ivory white with numerous scaly spiral cords; about 12 cords closely set on main convex area of body whorl, 3 above shoulder and 5 more widely spaced cords on lower body whorl and canal. Costae number approximately 8 on spire; those on body whorl (holotype) of regular close set growth but becoming obsolete on the remaining portion of the body whorl where a healed break occurs.

Aperture ovate with 9 plicae extending from lip edge and receding deeply within. Parietal wall smooth, with edge adherent, canal of moderate length, open, curved and reflected backwards. Operculum not seen.

Type material: Holotype: Australian Museum, Sydney, New South Wales, Australia, No. C.65908. A single paratype, American Museum of Natural History, No. 135640. Trawled in 55-58 fathoms, 18 miles N.N.E. of Cape Moreton, due east of Caloundra, Queensland.

Discussion: The systematics of the Magilidae based on essentially slight modifications of shell morphology is in need of more adequate study before a sound basis for classification can be realized. The supraspecific categories now employed (Wenz, 1941) are at best of provisional value pending further studies on the biology of the soft parts and phylogeny.

The generic division to which *Pseudomurex* belongs is one of world-wide distribution, in tropical and subtropical waters. Two nominal

---

* Associate. The American Museum of Natural History, New York, New York.

species of *Latiaxis* that have been cited as *Coralliophila akibumi* Kira, 1962, from Tosa Bay, Japan, and "*Fusomurex alucoides* (Blainville)" Coen, 1922, from the Mediterranean Sea, have shell characters that, in a general way, ally them to *L. garrardi*. *L. akibumi* is of finer growth, its spiral cords are more widely spaced with minor intercallating cords, the aperture is proportionately larger, and the spire shorter (see pl. 1, bottom right figs.). In addition, *L. akibumii* has a bone white shell. "*Fusomurex alucoides* (Blainville)" has fewer but more elevated spiral cords, the axial costae are regularly more pronounced and the scabrous ornamentation is finer (see pl. 1, bottom left figs.).

The single paratype of the new species is only semi-mature, apparently at the same stage of growth represented by the photograph before me of the third specimen. At this stage of early growth, the coarseness of surface sculpture, which is characteristic of this species, is more conspicuously developed.

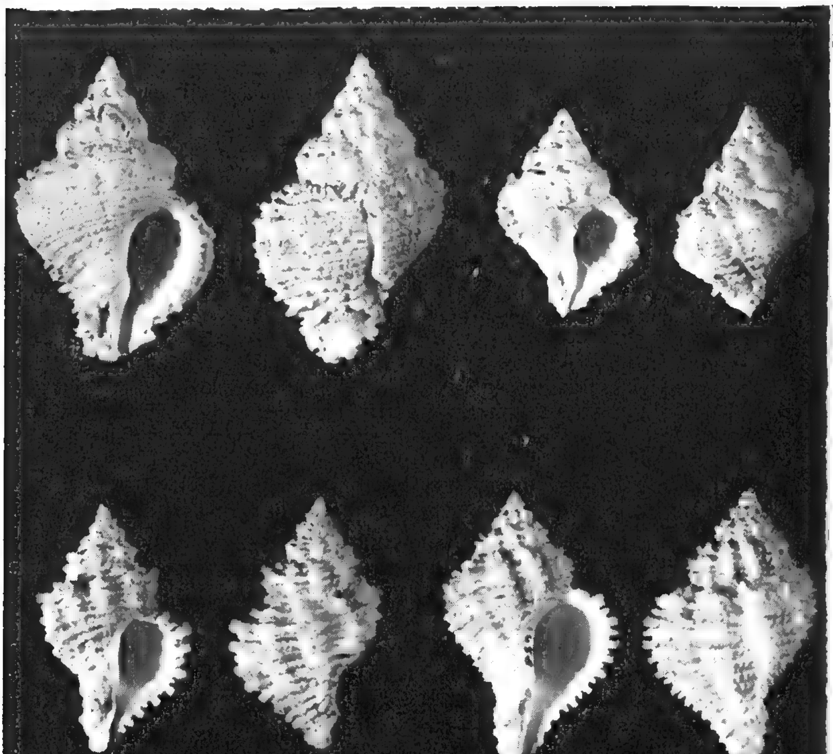


PLATE 1

Top left two figs: *Latiaxis* (*Pseudomurex*) *garrardi* n.sp. Holotype (A.M. No. C.65908). Top right two figs: *L.* (*P.*) *garrardi* n.sp. Paratype (A.M.N.H. No. 135640). Bottom left two figs: *L.* (*P.*) *alucoides* (Blainville), Melilla, Spanish Morroco, ? depth trawled. Bottom right two figs: *L.* (*P.*) *akibumii* (Kira), Tosa Bay, Japan, 100 fm.

ADDENDUM

Since this manuscript was submitted, I have had an opportunity to examine a copy of the rare book, *Malacozoaries,* by H. M. Ducrotay de Blainville, comprising part of the *Fauna Français. Murex alucoides* was described on page 128, pl. 56, fig. 1. According to a compilation of dates of publication by Sherborn and Woodward, in *Annals and Mag. Nat. Hist.,* 1901, this part or page of Blainville's work appeared in March 1829. However, Giuseppe Olivi had previously employed the combination, *Murex alucoides,* for a different species in *Zoologia Adriatica,* in 1792. Thus Blainville's usage is a homonym.

ACKNOWLEDGEMENTS

The following have contributed most generously to the writing of this paper: Dr. William K. Emerson, my colleague at the American Museum of Natural History, for critical help needed in many ways; and Mr. Norman Tebble, Curator of Mollusks at the British Museum (Natural History) for kindly checking photographs submitted to him of the new species with the collections of that Museum.

LITERATURE CITED

COEN, G., 1922. Del genere *Pseudomurex* (Monterosato, 1872). Atti Soc. Ital. Sci. Nat., 16: 68-71, pl. 2.

KIRA, T., 1962. *Shells of the western Pacific in color,* p. 68, pl. 26, fig. 3.

McMICHAEL, D. F., 1961. New species and new records of marine Mollusca from Australia. *J. Malac. Soc. Aust.,* 5: 51-57.

WENZ, W., 1941. Gastropoda, Familia Magilidae (Coralliophilidae). *Handbuch der Paläozoologie (Schindewolf),* 6, (2), pt. 5: 1129-1135.

BERNARD CHARLES COTTON (1905-1966)

Obituary, Bibliography and Index of his New Scientific Names

By

HELENE M. LAWS*

and

HANS MINCHAM*

Bernard Charles Cotton, Curator of Molluscs at the South Australian Museum for 28 years, died on 3rd May 1966, aged 61. Born in Sheffield, England, he came to South Australia with his parents in 1923 and, a few months after his arrival, joined the staff of the South Australian Museum as a cadet to assist Sir Joseph Verco, the Honorary Conchologist. His first work was to help in the preparation of card catalogues of shells. He soon advanced to the position of Museum Assistant and Photographer, and in 1928 was appointed Assistant Conchologist. He was trained in conchology for 10 years by Sir Joseph Verco and, following Sir Joseph's death in 1934, was appointed Curator of Molluscs. Declining health necessitated his retirement from the Museum staff in 1962 after almost 40 years of service.

Cotton's bibliography reveals an outstanding contribution to Australian malacology. From this it is readily apparent that, while maintaining a high output of scientific writings, he also produced much to make the study of molluscs appeal to naturalists and the general public including the young. Of his published material, his major works are the four volumes published by the South Australian Branch of the British Science Guild, the first two of which were produced in collaboration with F. K. Godfrey.

Bernard Cotton was a Fellow of the Royal Society of South Australia from 1929, held office as a member of the Council for a number of years, served as vice-President (1949-50, 1951-2), President (1950-51) and finally as Programme Secretary (1959-62). In the Transactions of the Society he published 20 papers, 6 of which were in collaboration with other authors.

For many years Cotton was an active member of the Field Naturalists' Society of South Australia in which he served as Treasurer, Editor and Chairman. In 1964 the Society accorded him its highest award by electing him an Honorary Life Member.

In 1950 he was awarded the Natural History Medallion—a tribute to his research and work of "increasing knowledge and appreciation of Natural History in Australia".

Cotton was a Foundation Patron of the Malacological Society of Australia (portrait: *J. Malac. Soc. Aust.*, 3:3, 1959) and was made a Fellow and Honorary Life Member of the Royal Zoological Society of New South Wales. He was a Foundation Member and first President of the Malacological Section of the Royal Society of South Australia. In 1957 he was appointed Honorary Consulting Malacologist

* South Australian Museum, Adelaide, South Australia.

to the Natural Science Foundation, Philadephia, U.S.A. The South Australian Department of Mines seconded him in 1947 to identify fossil Mollusca from bores, work that he mantained for two and a half years.

An activity that appealed to him was editing and he found time, somehow, to do a considerable amount of editorial work. For 17 years he edited the quarterly "The South Australian Naturalist". Working upon notes left by the author he edited Sir Joseph Verco's "Combing the Southern Seas", a book published in 1935. He was the editor of the 1964 edition of "South Australian National Parks and Wild Life Reserves", a revision and enlargement of two earlier editions both of which he edited. His final work in this field was "Aboriginal Man of South and Central Australia", the latest handbook issued by the South Australian Branch of the British Science Guild Handbooks Committee. This was published only a few weeks before his death.

Bernard Cotton had plans for years of work upon which to expend his retirement. There were further parts of "Aboriginal Man" to edit and at least one book to write, among other things. Life ran out too soon for him but he filled his years well.

He is survived by Mrs. Cotton and two married daughters.

BIBLIOGRAPHY

The bibliography which follows covers Bernard Cotton's scientific publications from his first paper, in collaboration with Verco, in 1928, until the time of his death. All titles are arranged in strict chronological order of publication and those which include descriptions of new species and genera are marked with an asterisk.

During his lifetime Cotton also wrote many articles for newspapers and popular magazines. It was inevitable that some of his publications would be intermediate between the scientific and the popular. These have been weighed individually, some being included in the bibliography below and others being set aside as being of a popular nature.

CHRONOLOGICAL LIST OF PAPERS

1928

1. South Australian Cephalopoda. (Sir Joseph Verco & B.C.C.). *Rec. S. Aust. Mus.*, 4 (1):125-133. Sept. 30.

1929

*2. Contributions to the Fauna of Rottnest Island. IV. Western Australian Sepiidae. *J. Proc. R. Soc. West. Aust.*, 15: 87-91. July 25.

1930

*3. Fissurellidae from the "Flindersian" Region, Southern Australia. *Rec. S. Aust. Mus.*, 4 (2): 219-222. July 18.

*4. Pelecypoda of the Flindersian Region, Southern Australia. No. 1. *Rec. S. Aust. Mus.*, 4 (2):223-240. July 18.

*5. A New Species of the Genus *Emarginula* from the Capricorn Group. *Rec. S. Aust. Mus.*, 4 (2):241. July 18.

6. Notes on Australian Polyplacophora. (E. Ashby & B.C.C.). *Trans. R. Soc. S. Aust.*, 54:57-58. Dec. 20.

1931

7. Bird Notes. *S. Aust. Orn.*, 11 (1):21. Jan. 1.
8. The Spermatophore of *Sepioteuthis australis* (Quoy & Gaimard). (Sir Joseph Verco & B.C.C.). *Proc. Malac. Soc. Lond.*, 19 (4):168-170. Mar. 14.
*9. Cuttlebones from Robe with Description of a new Species. *S. Aust. Nat.*, 12 (3):39-41. May.
*10. Pelecypoda of the Flindersian Region, Southern Australia. No. 2. *Rec. S. Aust. Mus.*, 4 (3):333-354. June 30.
*11. South Australian Shells. Part I. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.*, 12 (4):51-63. Aug.
*12. Nomenclatural Note. *S. Aust. Nat.*, 12 (4):63. Aug.
*13. South Australian Shells. Part II. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.*, 13 (1):5-23. Nov.

1932

*14. South Australian Shells. Part III. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.*, 13 (2):35-86. Feb.
*15. Australian *Unionidae*. (B.C.C. & C. J. Gabriel). *Proc. R. Soc. Vict.*, N.S., 44 (2):155-160. April.
*16. South Australian Shells. Part IV. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.*, 13 (3):92-111. May.
17. Bird Notes. *S. Aust. Orn.*, 11 (7):198-199. July 1.
*18. Notes on Australian Mollusca, with Descriptions of New Genera and New Species. *Rec. S. Aust. Mus.*, 4 (4):537-547. July 31.
*19. South Australian Shells. Part V. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.*, 13 (4):127-176. Aug.
*20. South Australian Shells. Part VI. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.*, 14 (1):16-44. Nov.

1933

21. Bird Notes. *S. Aust. Orn.*, 12(2):65. April.
*22. South Australian Shells. Part VII. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.*, 14 (3):72-108. May.
23. Bird Notes. *S. Aust. Orn.*, 12 (3):100-101. July 1.
24. Obituary and Bibliography of Conchological Works of Sir Joseph Cooke Verco. *S. Aust. Nat.*, 14 (4):121-124. Aug. 21.
25. Remarks on the New Harpid (Mollusca) Genera of Finlay and Iredale. (B.C.C. & N. H. Woods). *Rec. S. Aust. Mus.*, 5 (1): 45-47. Aug. 31.
*26. South Australian Shells. Part VIII. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.*, 14 (4):135-150. Aug. 31.
27. Notes on the Turton Collection of Chitons. (E. Ashby & B.C.C.). *Proc. Malac. Soc. Lond.*, 20 (6):320. Nov. 15.
28. An American Fresh-Water Snail from the River Murray at Blanchetown. *S. Aust. Nat.*, 15 (1):8. Nov. 30.
*29. South Australian Shells. Part IX. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.*, 15 (1):14-24. Nov. 30.

1934

*30. South Australian Shells. Part X. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.*, 15 (2):41-56. Mar. 27.
31. Bird Notes. *S. Aust. Orn.*, 12 (6):215. April 1.
*32. South Australian Shells. Part XI. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.* 15 (3):77-92. June 12.
*33. Pelecypoda of the Flindersian Region, Southern Australia. No. 3. *Rec. S. Aust. Mus.*, 5 (2):173-178. July 31.

*34. South Australian Shells. Part XII. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.,* 15 (4):106-112 & 114-121. Sept. 20.
35. A Freshwater Mussel Attached to a Duck's Foot. *S. Aust. Nat.,* 15 (4):113. Sept. 20.
*36. New Species of Chitons from Broome, Western Australia. (E. Ashby & B.C.C.). *J. Proc. R. Soc. West. Aust.,* 20:213-219. Dec. 3.
*37. South Australian Shells. Part XIII. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.,* 16 (1):1-6. Dec. 15.
*38. A New Species of Fossil Shell from the Upper Pliocene of the Adelaide Plains. *S. Aust. Nat.,* 16 (1):7. Dec. 15.

1935

39. Bird Notes. *S. Aust. Orn.,* 13 (1):21-22. Jan. 1.
40. Bird Notes. *S. Aust. Orn.,* 13 (2):58-59. April 1.
*41. South Australian Shells. Part XIII (B.C.C. & F. K. Godfrey). *S. Aust. Nat.,* 16 (2):13-24. April 10.
*42. South Australian Shells. Part XV. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.,* 16 (3):34-41. July 24.
*43. Recent Australian Viviparidae and a Fossil Species. *Rec. S. Aust. Mus.,* 5 (3):339-344. Sept. 30.
*44. The Correlation of Recent and Fossil *Turritellidae* of Southern Australia. (B.C.C. & N. H. Woods). *Rec. S. Aust. Mus.,* 5 (3):369-387. Sept. 30.
45. Descriptions of Fossil Chitons from Europe in the Ashby Collection at the South Australian Museum. (E. Ashby & B.C.C.). *Rec. S. Aust. Mus.* 5 (3):389-394. Sept. 30.
46. Bird Notes. Birds noted on Yorke Peninsula in September, 1935. *S. Aust. Orn.* 13 (4):125. Oct. 1.
*47. The Australian Viviparous River Snails. *Victorian Nat.,* 52: 96-99. Oct.
*48. The Genus *Cheilea* in Australian Waters. *J. Proc. R. Soc. West. Aust.,* 21:153-154. Dec. 18.

1936

*49. A New Fossil Bivalve Mollusc from South Australia. *Rec. S. Aust. Mus.,* 5 (4):503-504. Nov. 30.
50. The Southern Australian Baler Shell. *Melo miltonis* Gray. *Rec. S. Aust. Mus.,* 5 (4):505-508. Nov. 30.
*51. South Australian Fossil Chitons. (E. Ashby & B.C.C.). *Rec. S. Aust. Mus.,* 5 (4):509-512. Nov. 30.
*52. Description of a New Cerithoid Fossil Shell. (Professor W. Howchin & B.C.C.). *Trans. R. Soc. S. Aust.,* 60:31-32. Dec. 23.
53. Shells of the National Park. *S. Aust. Nat.,* 17 (1-4):83-85. 1936. (Issued separately as National Park Morialta and Waterfall Gully Reserves. Edited by B. C. Cotton. Adelaide. 1936).

1937

54. Records of Snails and Slugs Introduced to South Australia. *S. Aust. Nat.,* 16 (4):58-60. March 24.
*55. Loricata. *Rep. B.A.N.Z. Antarct. Res. Exped.,* Ser. B: 4(1):9-19. Aug. 20.
56. Brachiopoda. *Rep. B.A.N.Z. Antarct. Res. Exped.,* Ser. B: 4(1): 20-22. Aug. 20.
*57. Nomenclatural Note. *S. Aust. Nat.,* 18 (1):2. Sept. 30.
58. Eggs and Egg Cases of Some Southern Australian Mollusca. *Rec. S. Aust. Mus.,* 6 (1):101-103. Nov. 30.

*59. Description of Two New Species of Australian Chitons with Additional Notes and Records. (E. Ashby & B.C.C.). *Trans. R. Soc. S. Aust.*, 61:145-148. Dec. 24.

1938

60. *The Molluscs of South Australia. Part I. The Pelecypoda*: 1-314. Government Printer, Adelaide. Mar. 20.
61. Obituary—The Late W. J. Kimber. *S. Aust. Nat.*, 18 (3): 63. April 30.
62. The Spermatophore of *Rossia australis* Berry. *Proc. R. Soc. Vict.*, 50 (2):338-340. May 23.
63. *Ephippodonta*—South Australia's Most Peculiar Bivalve Shell. *Victorian Nat.*, 55:58-61. Aug.
*64. Recent and Fossil Species of the Scaphopod Genus *Dentalium* in Southern Australia. (B.C.C. & N. H. Ludbrook). *Trans. R. Soc. S. Aust.*, 62 (2):217-228. Dec. 23.
*65. New Species of South Australian Gastropoda. (B.C.C. & F. K. Godfrey). *Rec. S. Aust. Mus.*, 6 (2):199-206. Dec. 24.
66. A Systematic List of the Gastropoda. The Marine, Freshwater, and Land Univalve Mollusca of South and Central Australia. (B.C.C. & F. K. Godfrey). *The Malacological Society of South Australia. Publication* No. 1:1-44. Dec. 31.

1939

67. Bird Notes. Galah (*Kakatoe roseicapilla*). *S. Aust. Orn.*, 15 (1):16. Jan. 1.
*68. Reports of the McCoy Society for Field Investigation and Research. No. 3. Sir Joseph Banks Islands. Part II. Mollusca, Part 2, General. *Proc. R. Soc. Vict.* 51 (1): 159-176. Jan. 23.
69. Observations on a Native Land Snail *Exilibadistes sutilosa* (Deshayers, 1850). (B.C.C. & W. M. Nielsen). *S. Aust. Nat.*, 19 (3):16. April 29.
70. An Imported Snail. "*The Farmer*", Moonta, South Australia. May 5.
71. The Black Cowry. "*The Farmer*", Moonta, South Australia. June 23.
72. The Mallee Fowl's Nest. *S. Aust. Orn.*, 15 (3):46-47. July 1.
*73. New Fossil Chitons from the Miocene and Pliocene of Victoria. (E. Ashby & B.C.C.). *Rec. S. Aust. Mus.* 6 (3):209-242. Dec. 16.
*74. Flindersian Loricates. (B.C.C. & B. J. Weeding). *Trans. R. Soc. S. Aust.*, 63 (2):181-199. Dec. 22.
*75. Land Shells from the Northern Flinders Range. *S. Aust. Nat.*, 20 (1):3-6. Dec. 30.

1940

*76. The Land Shells of Kangaroo Island. *S. Aust. Nat.*, 20 (3): 40-42. Sept. 30.
77. Sea Shore Shells of South Australia. (B.C.C. & F. K. Godfrey). *S. Aust. Nat.*, 20 (4):49-60. Nov. 30.
78. Large Sea Urchins from New Guinea. *S. Aust. Nat.*, 20 (4):60. Nov. 30.
79. The Kalutara Snail *Achatina fulica* Ferussac Attacks Rubber Trees in Ceylon. *S. Aust. Nat.*, 20 (4):65. Nov. 30.
80. *The Molluscs of South Australia. Part II. Scaphopoda, Cephalopoda, Aplacophora and Crepipoda*: 315-600. (B.C.C. & F. K. Godfrey). Government Printer, Adelaide. Dec. 20.
81. A Systematic List of Pelecypoda, Scaphopoda, Cephalopoda and Crepipoda. The Bivalve Mollusca, Tusk-Shells, Nautilus, Squids, Octopi and Chitons of South Australia. *The Malacological Society of South Australia. Publication* No. 2:1-32. Dec. 31.

1941

82. The Correlation of Recent and Fossil Crepipoda (Mollusca) of the Australian Sub-Region. (B.C.C. & B. J. Weeding). *Rec. S. Aust. Mus.*, 6 (4):435-450. Feb. 28.

*83. A New Species of Land Shell from Salamo, Fergusson Island, New Guinea. *S. Aust. Nat.*, 21 (1):5-6. May 31.

*84. Fresh Water Snails From The River Torrens. (B.C.C. & A. K. Beasley). *S. Aust. Nat.*, 21 (1):17. May 31.

1942

85. The Southern Bailer Shell. *S. Aust. Nat.*, 21 (3):14. July 14.

86. Barrett's Land Shell. *S. Aust. Nat.*, 21 (3):16. July 14.

*87. Some Australian Freshwater Gasteropoda. *Trans. R. Soc. S. Aust.*, 66 (1):75-82. July 31.

88. Cephalopoda from the Stomach Contents of Fish from East and South Australia. *Trans. R. Soc. S. Aust.*, 66 (1):83-84. July 31.

89. A Teal with a Broken Humerus. (H. E. Dunstone & B.C.C.). *S. Aust. Nat.*, 21 (4):3. Dec. 1.

*90. Australian Gastropoda of the Families Hydrobiidae, Assimineidae and Acmeidae. *Trans. R. Soc. S. Aust.*, 66 (2):124-129. Dec. 18.

*91. Echinodermata of the Flindersian Region Southern Australia. (B.C.C. & F. K. Godfrey). *Rec. S. Aust. Mus.*, 7 (2): 193-234. Dec. 24.

92. *Idiellana*, A New Name for the Preoccupied Genus *Idiella* Stechow. (B.C.C. & F. K. Godfrey). *Rec. S. Aust. Mus.*, 7 (2):234. Dec. 24.

1943

93. Echinodermata, Brachiopoda, *in* A Systematic List of the Echinodermata, Foraminifera, Hydroida, Brachiopoda of South Australia. (B.C.C. & F. K. Godfrey). *Rec. Soc. S. Aust., Malacological Section, Publication* No. 3. Jan. 30.

94. More Australian Fresh Water Shells. *Trans. R. Soc. S. Aust.*, 67 (1):143-148. July 30.

*95. Australian Shells of the Family Haliotidae. *Trans. R. Soc. S. Aust.*, 67 (1):175-180. Nov. 30.

96. The Paper Nautilus *Argonauta nodosa* (Solander, 1786) taken on the eastern Gulf St. Vincent Beaches. *Trans. R. Soc. S. Aust.*, 67 (1):180. Nov. 30.

*97. The Cowries (Cypraeidae) of Fiji. (W. R. Steadman & B.C.C.). *Rec. S. Aust. Mus.*, 7 (4):309-336. Nov. 30.

98. Killer Whales in South Australia. *S. Aust. Nat.*, 22 (2):2. Dec. 10.

99. Paper Nautilus and Loggerhead Turtle Reported. *S. Aust. Nat.*, 22 (2):14. Dec. 10.

100. Fijian Cowries. (W. R. Steadman & B.C.C.). *S. Aust. Nat.*, 22 (2):15. Dec. 10.

1944

101. Egg Capsule of the South Australian Baler Shell *Melo miltonis* Gray. *Rec. S. Aust. Mus.* 8 (1):143-144. April 24.

*102. Australian Margin Shells (Marginellidae). *S. Aust. Nat.* 22 (4):9-16. Nov. 30.

*103. Recent Australian Species of Rissoidae (Mollusca). *Trans. R. Soc. S. Aust.*, 68 (2):286-314. Nov. 30.

1945

*104. A Catalogue of the Cone Shells (*Conidae*) in the South Australian Museum. *Rec. S. Aust. Mus.*, 8 (2):229-280. June 30.

*105. Southern Australian Gastropoda. Part I. Streptoneura. *Trans . R. Soc. S. Aust.*, 69 (1):150-171. July 27.

106. Oysters—Free. *S. Aust. Nat.*, 23 (2):10-11. Oct. 15.

*107. Australian Keyhole Limpets. *S. Aust. Nat.*, 23 (2):13-16. Oct. 15.

*108. Southern Australian Gastropoda. Part II. Doliacea. *Trans. R. Soc. S. Aust.*, 69 (2):249-262. Nov. 30.

1946

109. Australian Beaded Top Shells. *S. Aust. Nat.*, 23 (3):6-8. Feb. 15.

110. *South Australian Shells.* South Australian Museum Publication. (1st edition). Feb.

111. Australian Limpets of the Family *Lottiidae*. *S. Aust. Nat.*, 23 (4):14-16. June 1.

*112. A Key to the Classification of the Cowries (*Cypraeidae*). (W. R. Steadman & B.C.C.). *Rec. S. Aust. Mus.*, 8 (3): 503-530. June 30.

113. Some Raised Beaches of the Lower South-East of South Australia and Their Significance. *Trans. R. Soc. S. Aust.*, 70 (1):64-82. Dec. 1.

*114. Some Rare Southern Australian Shells. *S. Aust. Nat.*, 24 (1): 13-16. Sept. 2.

1947

115. Australian Limpets of the Family Patellidae. *S. Aust. Nat.*, 24 (2):14-16. Jan. 1.

*116. Some Southern Australian Turridae. *S. Aust. Nat.*, 24 (3):13-16. April 1.

117. Australian Recent and Tertiary Turridae. *Field Naturalists's Section of the Royal Society of South Australia. Conchology Club. Publication* No. 4. June 30.

*118. Some Tertiary Fossil Molluscs from the Adelaidean Stage (Pliocene) of South Australia. *Rec. S. Aust. Mus.*, 8 (4):653-670. Dec. 10.

1948

119. Australian Cone Shells. *Field Naturalists' Section of the Royal Society of South Australia. Conchology Club. Publication* No. 5. Jan. 1.

120. Australian Recent and Tertiary Cypraeacea (Cowries). *S. Aust. Nat.*, 24 (4):11-15. April 1.

*121. Southern Australian Gastropoda. Part III. *Trans. R. Soc. S. Aust.*, 72 (1):30-32. Aug. 23.

122. Lake Macdonnell Gypsum Deposit. Appendix I, Palaeontological Examination. *South Australian Mining Review*, 87:130-132. Feb. 1.

1949

*123. Australian Recent and Tertiary Mollusca. Family Volutidae. *Rec. S. Aust. Mus.*, 9 (2):181-196. May 31.

*124. Australian Recent and Tertiary Mollusca. Family Marginellidae. *Rec. S. Aust. Mus.*, 9 (2):197-224. May 31.

*125. A New *Aturia* from the Tertiary of South Australia. (C. Teichert & B.C.C.). *Rec. S. Aust. Mus.*, 9 (2):255-256. May 31.

126. The Drilling of a trial Borehole on the Lake Macdonnell Salt and Gypsum Deposits, Appendix I, Palaeontological Examination. *South Australian Mining Review*, 88:268. Nov. 21.

127. An Old Mangrove Mud-flat Exposed by Wave Scouring at Glenelg, South Australia. *Trans. R. Soc. S. Aust.*, 73 (1):59-61. Dec.

128. Fossil Oysters used for Road Metal. *Trans. R. Soc. S. Aust.*, 73 (1):62. Dec.

1950

129. Mollusca from Western Australia. *Rec. S. Aust. Mus.*, 9 (3): 333-338. June 30.

130. Pleistocene Land and Freshwater Shells from South Australia. *Rec. S. Aust. Mus.*, 9 (3):352. June 30.

1951

*131. Australian Recent and Tertiary Mollusca, Family Cerithiopsidae. *Rec. S. Aust. Mus.*, 9 (4):383-396. June 30.

1952

132. Family Haliotidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 1:3pp. July 21.

*133. Australian Recent and Tertiary Mollusca (Terebridae, Rissoinidae, Rissoidae, Fasciolariidae, Volutidae). *Trans. R. Soc. S. Aust.*, 75:38-54. Sept.

134. Family Cerithiidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 2:4pp. Nov. 3.

135. Geology and Underground Water Resources of the Adelaide Plains Area, Appendix III, Stratigraphy and Palaeontology of the Subsurface Deposits of the Adelaide Plains. (B.C.C. & I. Crespin). *Department of Mines (Geological Survey of South Australia). Bulletin* 27:227-238. Nov.

*136. Geology and Underground Water Resources of the Adelaide Plains Area, Appendix IV, The Mollusca of the Adelaidean Stage. *Department of Mines (Geological Survey of South Australia). Bulletin* 27:239-249. Nov.

1953

137. Family Strombidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 3 4 pp. Nov. 16.

*138. New Species and Records of Mollusca from South Australia. *Trans. R. Soc. S. Aust.*, 76:21-26. Dec.

139. Shells of the National Park and Reserves: 137-146, *in National Park and Reserves,* edited B. C. Cotton. Commissioners of the National Park, 197pp.

1954

140. Western Australian Pearl Shells. *West Aust. Nat.* 4 (4):83-84. Mar. 30.

141. Mollusca of the Outer Harbor, South Australia. *Rec. S. Aust. Mus.*, 11 (2):165-176. May 28.

142. A Catalogue of Introduced Snails and Slugs in Australia. *Rec. S. Aust. Mus.*, 11 (2):177-187. May 28.

*143. Family Cassididae. *R. Soc. S. Aust., Malacological Section, Publication* No. 4:4pp. June 30.

144. Family Naticidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 5:5pp. July 31.

1955

145. Family Olividae. *R. Soc. S. Aust., Malacological Section Publication* No. 6:4pp. May 30.
146. Fatal Bite from Octopus. (H. Flecker & B.C.C.). *Med. J. Aust.* 1955:329-332. Aug. 27.
147. Family Nassariidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 7:4pp. Aug. 30.

1956

148. Family Muricidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 8:8pp. Feb. 2.
149. Family Thaididae. *Malacological Club of Victoria, Publication* No. 1. July 1.
150. Family Scalidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 9:4pp. July 2.
151. Family Littorinidae. *Malacological Club of Victoria, Publication* No. 2. Oct. 1.
152. Family Buccinidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 10:4pp. Oct. 15.

1957

153. Family Fasciolariidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 11:4pp.
154. *Australian Recent and Tertiary Species of the Molluscan Family Volutidae.* Publ. B. C. Cotton. 4pp. Mar. 18.
155. Family Turritellidae. *Malacological Society of Australia, Publication* No. 3. Mar. 19.
156. Family Cymatiidae. *Malacological Society of Australia, Publication* No. 4. April 12.
*157. Records of Uncommon Southern Australian Mollusca. *Rec. S. Aust. Mus.*, 13 (1):117-130. April 30.
158. *Australian Recent and Tertiary Species of the Molluscan Family Pyrenidae.* Pub. B. C. Cotton. May 30.
159. Family Mitridae. *R. Soc. S. Aust., Malacological Section, Publication* No. 12:8pp. Sept. 2.
160. The Lightning Volute *Ericusa fulgetrum* Sowerby. *J. Malac. Soc. Aust.*, 1:8-10. Sept.
161. A Rare Pelecypod from South Australia. *S. Aust. Nat.*, 32 (2):22. Dec.

1958

162. Note on *Nautilus repertus* and *Nautilus scrobiculatus. Trans. R. Soc. S. Aust.*, 81:113. Mar.
163. *Australian Recent and Tertiary Species of the Molluscan Family Conidae.* Publ. B. C. Cotton. 4pp. Sept. 1.
163a. Western Australian Cowries. *J. Malac. Soc. Aust.*, 2:8-15. Nov. 13.

1959

164. Family Potamididae. *R. Soc. S. Aust., Malacological Section, Publication* No. 13:4pp. Feb. 2.
165. *South Australian Mollusca. Archaeogastropoda.* Government Printer, Adelaide. 449pp. July 1.
166. Family Haliotidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 1 (revised):4pp. Sept. 1.
167. Family Strombidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 3 (revised):8pp. Dec. 7.

1960

*168. A New Species of Scallop *Notochlamys hallae sp. nov.* from South Australia. *R. Soc. S. Aust., Malacological Section, Publication* No. 14:2pp. Jan. 1.

169. Rare Shells Recently Dredged off St. Francis Island, South Australia. *S. Aust. Nat.,* 34 (3):47. Mar.

170. Distorted Cowries. *Trans. R. Soc. S. Aust.,* 83:109-110. Mar.

171. Mollusca Eaten by Birds. *S. Aust. Orn.,* 23 (3):44-47. June 1.

172. An Imcorted Snail (*Ferussacia*) Appears Again. *S. Aust. Nat.,* 34 (4):58. June.

173. Rare Shells Recently dredged off St. Francis Island, South Australia (continued). *S. Aust. Nat.,* 34 (4):52. June.

174. Family Cerithiidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 2. (revised):4pp. July 20.

175. Recent Alterations in Range and Abundance of Marine Invertebrates in South Australia. *West. Aust. Nat.* 7 (6): 137-141. Sept. 9.

175a. Notes and Records. A large *Notodarus* (sic) *gouldi* (McCoy, 1888). *J. Malac. Soc. Aust.,* 4:70. Nov. 13.

1961

176. Shell Sorting. *S. Aust. Nat.,* 35 (3):40-41. Mar.

*177. A new species of Volute, *Mesericusa stokesi* sp. nov. from South Australia. *R. Soc. S. Aust., Malacological Section, Publication* No. 16:4pp. May 10.

178. Family Cassididae. *R. Soc. S. Aust., Malacological Section, Publication* No. 4 (revised):4pp. July 3.

179. *South Australian Mollusca. Pelecypoda.* Government Printer, Adelaide. 363pp. Oct.

1963

180. *South Australian Shells.* South Australian Museum Publication. 5th Edition. Feb.

1964

181. *South Australian Mollusca. Chitons.* Government Printer, Adelaide. 151pp. Feb. 2.

182. Molluscs of the National Parks and Reserves: 120-129, *in South Australian National Parks and Wild Life Reserves,* edited B. C. Cotton. Commissioners of the National Park and Wild Life Reserves, 190pp.

183. Family Naticidae. *R. Soc. S. Aust., Malacological Section, Publication* No. 5 (revised):4pp. Aug.

184. *Beachcombing at the Outer Harbour South Australia.* South Australian Museum Publication. 2nd Edition. Aug.

185. Molluscs of Arnhem Land. *Rec. of the Am. Aust. Sci. Exped. to Arnhem Land* 4 (Zoology): 9-43. Oct.

LIST OF NAMES

The list below gives, in alphabetical order, all generic, subgeneric, specific and subspecific names proposed by Cotton (including those in collaboration with other authors). No distinction is made between names for genera and subgenera; specific and subspecific names are followed by the genus or genus and species under which they were originally proposed. The number following each name is that of the paper, from the bibliography above, in which it was first proposed; the second number is that of the page where it first occurs.

Bibliographic titles marked with an asterisk are those in which new names appear.

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to Mrs. B. C. Cotton for supplying many biographical details; they are also indebted to Miss Sue Bache for her assistance in the preparation of the bibliography and list of new names.

THE RECENT APPEARANCE OF *NOTOSPISULA TRIGONELLA* (LAMARCK) (MOLLUSCA; BIVALVIA; MACTRIDAE) IN THE SWAN ESTUARY

By B. R. WILSON* and
G. W. KENDRICK*

Plate 2.

A small bivalve, *Notospisula trigonella* (Lamarck, 1818), is at present extremely abundant in the Swan Estuary, Western Australia. Yet, in spite of considerable work on the fauna of this estuary in the last decade, or so, there is no positive record of its presence prior to 1964. Specimens have also been collected recently at other localities in Western Australia although the original description of the species from Shark Bay by Lamarck in 1818 is the only previous record of it in the state.

The fauna of the Swan Estuary is impoverished. Only a few species are able to persist within the estuary throughout the year because there are unusually severe seasonal changes in salinity (Serventy, 1955; Spencer, 1956; Wilson, 1964). During summer there is discharge of river water into the estuary which is filled with saline water carried in by weak tidal forces from the sea. In summer many marine organisms enter with the sea water and temporarily establish themselves. Most of these fail to survive the winters which are characterised in most years by a long period of flood conditions including almost complete scour of the estuary by fresh water.

Today *N. trigonella* is abundant throughout the lower estuary on the shallow sand cays and banks. The animals burrow in the sand with their long siphons extended through the water-sand interface. In places they are so abundant that they prickle the feet of persons wading in the water. They also occur in the mud in deeper channels. At the end of each winter recently-dead specimens are cast ashore in quantity indicating that the shallow populations are heavily depleted by the effect of the winter floods. However, some survive, or perhaps the shallows are repopulated from more saline water deeper down or further downstream.

Recent records: *N. trigonella* was first observed in the Swan Estuary in December 1964 when several live adult specimens were dredged at Canning Bridge by Mr and Mrs R. Slack-Smith of the Western Australian Fisheries Department. There is no information on how abundant or widespread they were at that time.

In September 1965, after the winter floods, vast numbers of empty but paired valves of this species were present along the beaches of Matilda Bay (Crawley) and the Nedlands foreshore. Lesser numbers were then present downstream at Minim Cove, North Fremantle and upstream at Belmont. Presumably a large population of the animals which had flourished during the previous summer, had been heavily depleted by

* Western Australian Museum, Beaufort St., Perth, W.A.

the winter floods of mid-1965. However, in mid-February 1966, a dense living population of the species was again present in shallow water on the sandy sills around the shores of Matilda Bay.

There are no records of *Notospisula* living in the Swan Estuary before 1964. Thiele (1930) did not list any mactrid when reporting the results of the 1905 Hamburg South-West Australian Expedition which had several collecting stations in the estuary. The genus is not listed in brief accounts of the fauna of the estuary by Serventy (1955) and Kendrick (1960). Between the years 1956 and 1963 the Marine Group of the W.A. Naturalists' Club made many excursions collecting invertebrates, particularly molluscs, in the Swan Estuary, yet made no record of *Notospisula* (Wilson and Kendrick, unpublished data). Nor was the species noticed during a study of the biology of a mussel in the Swan Estuary in the years 1960 to 1963 (Wilson, 1964).

At Careening Bay, Garden Island, five living specimens were collected on a shallow sandy sill in December 1965. The sand flats at the southern end of Careening Bay have been intensively but irregularly collected by the authors and associates since 1956. In February and March 1963, students of the Department of Zoology, University of Western Australia, conducted a detailed survey of the fauna of these flats (Phillips, 1963) but did not record *Notospisula.*

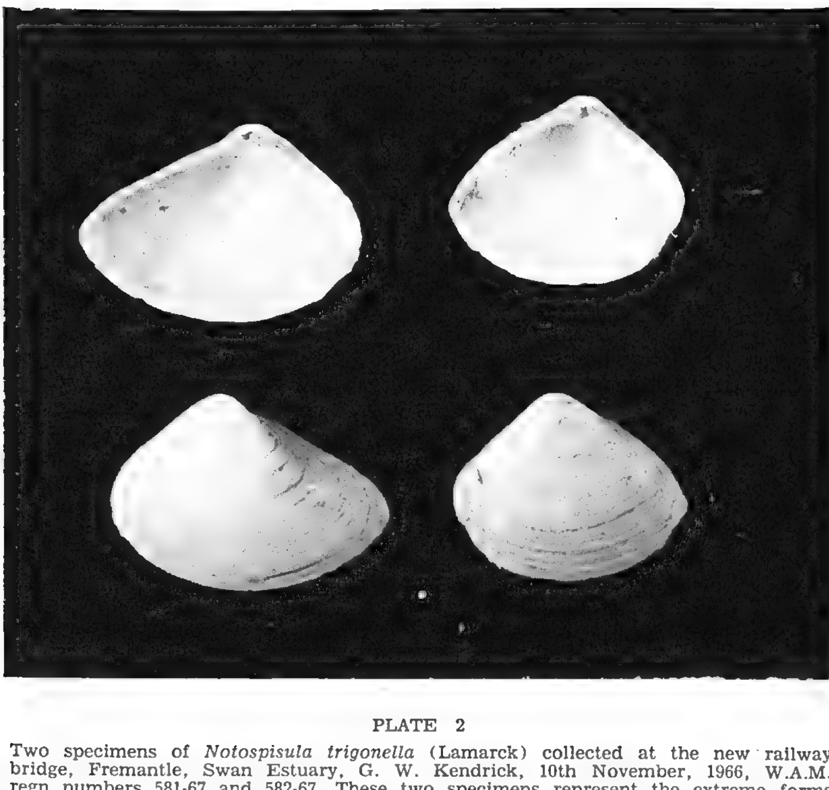


PLATE 2

Two specimens of *Notospisula trigonella* (Lamarck) collected at the new railway bridge, Fremantle, Swan Estuary, G. W. Kendrick, 10th November, 1966, W.A.M. regn numbers 581-67 and 582-67. These two specimens represent the extreme forms selected from a single sample (W.A.M. 580-67). Approx. double natural size.

Living specimens have been collected in April and December, 1965 on a sand bank just inside the mouth of Peel Inlet at Mandurah, and in January, 1967 in Nornalup Inlet on the south coast of Western Australia. These and other localities have been collected fairly thoroughly in recent years without previous record of *Notospisula,* but we are unable to certify that the species has become esablished there recently, although this seems probable.

In March 1966 we went to Shark Bay looking specifically for *Notospisula* but failed to find any there. Dr R. W. George dredged several single valves much further north off Troughton Island on 23 October 1962.

Fossil records: Extensive Quaternary shell-beds occur around the shores of the Swan Estuary. Reath (1925) listed many species of molluscs from Pleistocene faunas at Peppermint Grove and Minim Cove and from post-Pleistocene shell-beds of the lower Swan and Canning Rivers, but no mactrid was included in the list. The faunal list of the Pleistocene shell-beds was revised and extended by Kendrick (1960) but the additions included no mactrid. Nor have any been collected there during a more detailed study of the deposits since 1960. Intensive collecting of unconsolidated shell-beds of post-Pleistocene age, carried out by one of us since 1950, failed to produce any mactrid until recently.

It was not until September 1964 that *Notospisula* was first recorded from Quaternary shell-beds of the region. At that time Mrs Slack-Smith collected a small sample of shells from dumped material being used to reclaim part of the Swan Estuary near the Narrows Bridge. The sample included three pairs of articulated valves and one single valve.

In December 1965 single valves were found on a bank of dredged shelly material at the Victoria Park end of the Causeway. This particular dredging was begun in December, 1964.

Further records of *Notospisula* shells were made in March 1966 from re-worked post-Pleistocene shell-sand on the reclaimed foreshore at Attadale. This reclamation was carried out between October 1963 and October 1964 (personal communication Mr. C. C. Jameson, Western Australian Department of Public Works).

Thus it can be stated that the only occurrences of *Notospisula* known to us from Quaternary shell-beds of the Swan Estuary, come from material which was dredged less than a year before the initial discovery of living shells at Canning Bridge in December 1964. The specimens from all three sites have an intact epidermis, lack the chalky texture of the fossil shells, and have the appearance of recently-dead shells. While they could be fossils of the same age as the many shells with which they occur, it is more probable that they are of very recent origin, and were introduced into the shell-beds by the dredging operations.

TAXONOMY OF *NOTOSPISULA*

The generic name *Notospisula* was introduced by Iredale (1930) without description or explanation. *Gnathodon parva* Petit, 1853 was nominated as the type species, but Iredale also included in the new genus *Mactra trigonella* Lamarck, 1818, and *Spisula cretacea* Angas, 1867.

Because no reasons were advanced for the introduction of the new name, the status of *Notospisula* remains in doubt, but it must be accepted until a generic revision of the Mactridae is attempted.

Hedley (1901) recognized only one species of this group in eastern Australia, for which he used the name *Spisula parva* (Petit, 1853). He included as synonyms *Mactra rostrata* Reeve, 1854, *Mactra corbuloides* Deshayes, 1854, *Spisula cretacea* Angas, 1867, *Spisula producta* Angas, 1867, and *Mactra fluviatilis* Angas, 1871. Hedley remarked on the variability of this bivalve in size and shape.

Lamy (1914) reported on the four syntypes of *Mactra trigonella* Lamarck, 1818 which he stated were collected by Peron at Shark Bay, Western Australia. Iredale 1930 gave King George Sound as the type locality without explanation and Cotton (1961) followed suit. While Iredale may have had reasons for this change, without knowing what they were we prefer to accept the locality given by Lamarck and Lamy.

Lamy considered the type specimens identical with *Gnathodon parvum* Petit. Petit's types are probably also in the Paris Museum and it is presumed that Lamy compared them with Lamarck's specimens, although he did not say so.

Hedley (1916) followed Lamy and synonymized *parvum* Petit with *trigonella* Lamarck which has priority. Iredale (1930) rejected this conclusion, basing his opinions solely on the difference in locality and his ambiguous reference to "geographic variation". Iredale also considered *parvum* and *cretacea* distinct species, but again his reasons were not explained except for the statement that they are "easily separated".

We have examined the series of *Notospisula* in the Australian Museum which, presumably, includes the specimens examined by Hedley and Iredale, and we can recognize only one species. As Hedley (1901) remarked, the species is variable in shape. It is true that one can "easily separate" the extreme variants but most of the series is intermediate preventing the conclusion that the extreme forms represent distinct species.

For these reasons we find no support for Iredale's contention that *trigonella* Lamarck, *parvum* Petit and *cretacea* Angas are distinct species and we propose to follow Lamy and Hedley and unite them under the prior name *Notospisula trigonella* (Lamarck, 1818).

SYNONYMY

Notospisula trigonella (Lamarck, 1818)

Mactra trigonella Lamarck, 1818, *Anim. sans. vert. 5*: 479. (La baie des chiens marins [Shark Bay].) Four syntypes in Mus. National D'Hist. Nat., Paris, coll. by Peron, see Lamy, 1914, p. 245.

Gnathodon parvum Petit, 1853, *J. Conch., Paris, 4*: 358, pl. 13, figs 9-10 (Moreton Bay, Qld). Types in Mus. National D'Hist. Nat., Paris. ?

Mactra rostrata Reeve, 1854, *Conch. Icon.*, 8: pl. 19, fig. 104. (Moreton Bay, Qld). *non* Spengler, 1802; Philippi, 1846.

Mactra corbuloides Deshayes, 1854, *Proc. Zool. Soc. London,* p. 63 (Hab. ? , Mus. Cuming).

Spisula cretacea Angas, 1867. *Proc. Zool. Soc. London,* p. 909, pl. 44, fig. 6 (dredged at Port Stephens, off Tarlee (sic) [N.S.W.]).
Spisula producta Angas, 1867, *Proc. Zool. Soc. London,* p. 909, pl. 44, fig. 7 (Johnson's Bay and Parramatta River, Port Jackson [N.S.W.]).
Mactra fluviatilis Angas, 1871, *Proc. Zool. Soc. London,* p. 20, pl. 1, fig. 31 (dredged in brackish water, in 2 fathoms Hawkesbury River, New South Wales).

DISTRIBUTION

Today *N. trigonella* occurs around the whole coast of Australia. It tolerates a wide variety of habitats, occurring at moderate depths (50 fathoms) in the open sea and in the shallows of sheltered bays and estuaries. It is able to flourish in brackish conditions.

Petit, Reeve and Angas each recorded *Notospisula trigonella* (under other names) from various eastern Australian localities during the mid-19th century and the Australian Museum material consists of specimens collected in the region at irregular intervals since then. There can be no doubt that the species has been well established in eastern and south-eastern Australia for a long time. On the other hand, we know of no confirmed record of the species in south-western Australia, apart from Lamarck's original description, until 1964.

Most of the following locality records are based on the specimens in the Australian Museum and the Western Australian Museum. Others have been taken from Cotton (1961) and Macpherson and Gabriel (1962).

LOCALITY RECORDS

Queensland: (Specimens in Aust. Mus.): 4 to 14 fm., Albany Passage, Torres Straits; Van Diemen Inlet; Green Island; Barny Point; Port Curtis; off Horsey River; Cardwell; Karumba; Caloundra; Stradbroke Island; Cribb Island sands, Moreton Bay.

New South Wales: (Specimens in Aust. Mus.): Lake Illawarra; Parramatta River; Lake Macquarie, Wyong Lake; Hawkesbury River; Sydney Harbour; Botany Bay; Dee Why Lagoon; Lake Malacoota (Vic.); Patonga.

Tasmania: (Specimens in Aust. Mus.): Tamar River.

Victoria: (see Macpherson & Gabriel 1962): Port Melbourne; South Melbourne; St. Kilda; Western Port.

South Australia: (see Cotton, 1961): Gulf St. Vincent; Encounter Bay; Beachport; Kingston; Glenelg River; Corney Point.

Western Australia: (Specimens in W. Aust. Mus.): 50 fm. 130 m. E.N.E. Troughton Island; 50 fm. 150 m. E.N.E. Troughton Island; various localities in Swan Estuary; intertidal flats, Careening Bay, Garden I.; Peel Inlet, Mandurah; sandy shallows, Nornalup Inlet, G. W. Kendrick, Jan. 1967.

Also Shark Bay (type loc.).

DISCUSSION

We conclude that *N. trigonella* first appeared in the vicinity of Fremantle in 1964 or perhaps in 1963. Since then it has flourished in the Swan Estuary where it is able to persist throughout the year. Small populations also occur in the Peel Inlet at Mandurah and in sheltered Careening Bay at Garden Island, and we believe that the

occurrence of the species at these localities is the result of the same recent introduction. We are less certain about the population in Nornalup Inlet because collecting along the south coast has been less thorough, but it seems likely that it too is of recent origin.

The specimens collected in 1962 off Troughton Island in the far north of Western Australia may represent a permanent continuation of the species' range from North Queensland.

The sudden appearance of *N. trigonella* in south Western Australia, and more particularly in the Swan Estuary, is an event of some significance and poses two major questions:

(i) Was their introduction and subsequent success merely the result of a unique, fortuitous event enabling larvae to establish themselves in a place which has always been suitable for them, but which they have not reached before?

(ii) Has the local environment changed so that pelagic larvae reaching the area occasionally were at last able to settle and flourish whereas previously it was unfavourable to them and they perished?

Accepting that there is only one species of *Notospisula* in Australia, the introduction could have been from northern populations or from the south-east. Environmental temperature change is unlikely to be involved because the species occurs through such a wide temperature range in other places. It seems most likely that an unusual or unique set of ocean currents, corresponding with the breeding season of a northern or a south-eastern population, carried larvae to the Fremantle area for the first time. However, great distances are involved.

The nearest northern locality recorded for *N. trigonella* is Shark Bay, about 500 miles north of the Swan Estuary, and no specimens have been collected there since the beginning of the 19th century. The nearest northern locality from which the species has been recorded since then is Troughton Island, well over two thousand miles away.

A source population may have been present but overlooked on the south coast of Western Australia (e.g. at Nornalup Inlet) in which case larvae must have been carried north around Cape Leeuwin. However, if the Nornalup Inlet population is of recent origin contemporaneous with the introduction into the Swan Estuary, then the source population was probably in South Australia. In either case extension of the species range northwards to the Swan Estuary would represent a significant achievement, since it would involve a journey for the larvae against the major water currents.

Whatever its origin, the sudden appearance of *N. trigonella* in the Swan Estuary and nearby localities is a striking example of change in a species' distribution.

One effect is already evident. Vast numbers of dead shells have been deposited within the upper substrate and on the beaches of the estuary which in many places were originally largely composed of fossil shell-beds. Soon it will be difficult to distinguish these recently-dead shells from the genuine fossils in the shell-beds. Such an event as this, if unrecorded, could adversely influence future interpretations of fossil faunas and stratigraphy of the important Pleistocene and post-Pleistocene sediments in the area.

ACKNOWLEDGMENTS

We are grateful to Mr Richard Slack-Smith and Mrs. Slack-Smith who collected the first specimens of *Notospisula* in the Swan Estuary and to Mrs Hope Black who identified those specimens. Dr D. F. McMichael kindly loaned us specimens in the collection of the Australian Museum. Dr J. McIntyre provided data on the species in estuaries of New South Wales. Dr R. W. George read the manuscript.

LITERATURE CITED

COTTON, BERNARD C., 1961. *South Australian Mollusca. Pelecypoda.* Govt. Printer. Adelaide. 363 pp.

HEDLEY, CHARLES, 1901. Studies on Australian Mollusca. Pt. 5. *Proc. Linn. Soc. N.S.W.,* 1901, 26, (4): 700-708, pl. 34.

HEDLEY, CHARLES, 1916. Studies on Australian Mollusca. Pt. 13. *Proc. Linn. Soc. N.S.W.,* 41 (4):681-719, pls. 46-52.

IREDALE, TOM, 1930. More notes on the marine mollusca of New South Wales. *Rec. Aust. Mus.,* 17 (9):384-407, pls. 62-65.

KENDRICK, GEORGE W., 1960. The fossil mollusca of the Peppermint Grove Limestone, Swan River District of Western Australia. *West. Aust. Nat.,* 7 (3):53-66.

LAMY, ED., 1914. Notes sur les espèces du genre *Mactra* décrites par Lamarck. *Bull. Mus. Hist. Nat. Paris,* 1914, no. 4:239-247.

MACPHERSON, J. HOPE AND C. J. GABRIEL, 1962. *Marine Molluscs of Victoria.* Melbourne University Press. 475 pp.

PHILLIPS, BRUCE F., 1963. *The fauna on a sandy shore at Careening Bay, Garden Island.* Unpublished thesis [in] library of University of Western Australia.

REATH, J. L., 1925. The mollusca from the sub-recent shell beds of the lower Swan River. *J. Proc. R. Soc. West. Aust.* 11:31-41.

SERVENTY, D. L., 1954. The fauna of the Swan River Estuary. Chapter 10, pp. 70-77, in *Swan River Reference Committee, report on Pollution of Swan River.* Govt. Printer, Perth.

SPENCER, R. S., 1956. Studies in Australian estuarine hydrology. II. The Swan River. *Aust. J. Mar. Freshw. Res.* 7:193-253.

THIELE, J., 1930. Gastropoda und Bivalvia. In: Michaelsen, W. and Hartmeyer, R. *Die Fauna Südwest-Australiens* 5:559-596.

WILSON, BARRY R., 1964. *Breeding biology of some Western Australian marine and estuarine Mytilidae (Mollusca: Bivalvia).* Unpublished thesis [in] library of University of Western Australia.

MONOGRAPH OF THE GENUS *LETITIA* (PAPUININAE: CAMAENIDAE)

By

WILLIAM J. CLENCH* and RUTH D. TURNER*

Plates 3-7, Text-figs 1, 2.

This study is the fourth in our series covering the Papuininae. There is very little known concerning the distribution and biology of the species in this genus. All species are rare in collections except *brumeriensis* and *zeno,* and even for these species preserved material is limited. Consequently this study has been based almost entirely on shells, but we hope that it may be supplemented by more anatomical data in a later report.

ACKNOWLEDGMENTS

We are most grateful to the Curators of Mollusks in the institutions listed below for the loan of material. In addition we are indebted to Peter Dance, Donald F. McMichael, and Adolph Zilch for photographs of type specimens. We are also indebted to Ralph W. Jackson and Anthony D'Attilio for the loan of specimens.

ABBREVIATIONS

AM —Australian Museum, Sydney, Australia
ANSP —Academy of Natural Sciences, Philadelphia, Pennsylvania
BMNH—British Museum (Natural History), London, England
CM —Field Museum of Natural History, Chicago, Illinois
MCZ —Museum of Comparative Zoology, Cambridge, Massachusetts
MM —Manchester Museum, Manchester, England
NMV —National Museum of Victoria, Melbourne, Australia
SMF —Senckenberg Museum, Frankfurt-am-Main, Germany
UM —Museum of Zoology, University of Michigan, Ann Arbor, Michigan
USNM —United States National Museum, Washington, D.C.

Genus *LETITIA* Iredale

Letitia Iredale 1941, *Aust. Zool.,* 10:78 (type species, *Helix brumeriensis* Forbes, original designation).

Shells imperforate, globose, (except *chapmani* Cox which has a somewhat extended spire) with a broadened columellar area, minutely sculptured, white or spirally banded with brown and generally appearing somewhat chalky. Periostracum very thin and usually deciduous. Lip purplish to reddish brown with occasional white-lipped forms appearing in *brumeriensis* and *comriei.* Parietal area in adults usually showing some of the same color as the lip.

The genus is divided into two subgenera on the basis of color pattern.

* Department of Mollusks, Museum of Comparative Zoology, Cambridge, Mass.

This genus, so far as presently known, is restricted to the eastern extremity of New Guinea, extending from the Gulf Division to the eastern most of the Louisiade Islands.

It is impossible to definitely relate this genus to others in the Papuininae at this time because of the lack of material, particularly material for anatomical studies. It appears to be most closely related to *Rhynchotrochus* and its subgenus *Pompalabia*. The texture, color, and color pattern of the shells, particularly of those in the subgenus *Saccoletitia*, show affinities to *R. kubaryi*. The indication of a papuinoid notch in *L.* (*S.*) *zeno* (Braz.) and the definite notch and rostrum of *L.* (*S.*) *secans* (Hedley) also relate these species to *Rhynchotrochus, s.s.* The colouring of the shell, particularly of the lip of the species in *Letitia, s.s.*, shows affinities with that of the subgenus *Pompalabia*. *Rhynchotrochus* (*Pompalabia*) *naso* v. Mts. and *Letitia* (*Letitia*) *chilochroa* (Da Costa) have many characters in common and may be considered transitional species, *naso* sharing more characters with *Rhynchotrochus* while *chilochroa* shares more with *Letitia*.

ANATOMICAL NOTES

Unfortunately all of the species of *Letitia* are rare and the soft parts are known for only one of the eight included species and subspecies. Hedley (1892) briefly described and figured the jaw, radula and genitalia of *brumeriensis*, the only species for which anatomical material was available for our study. The following description is based on dissection of only three specimens.

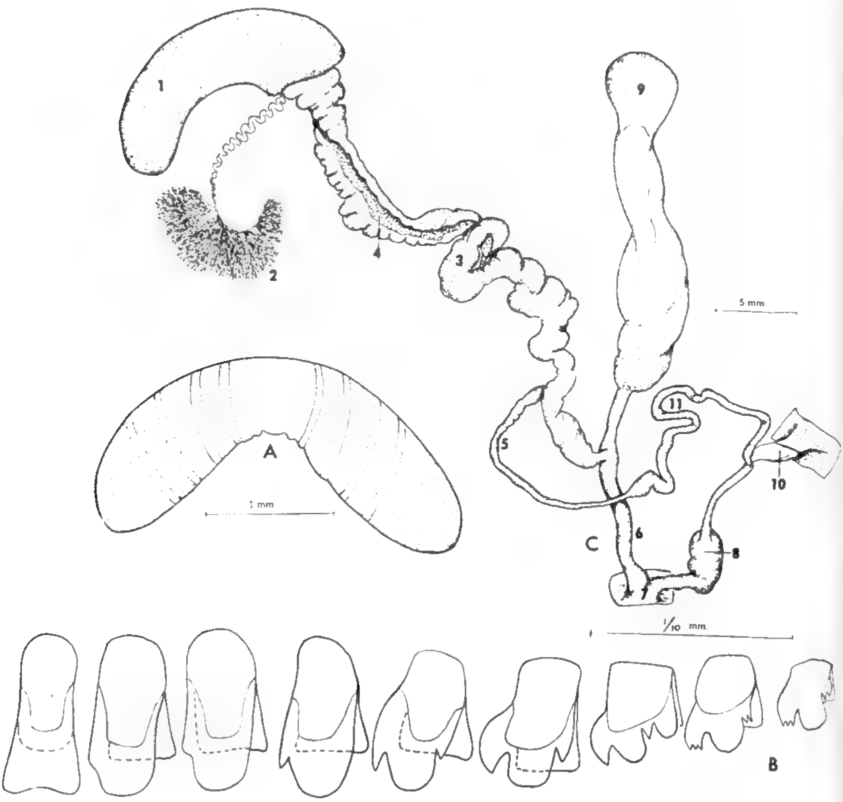
Hedley described the jaw as having "about nine weak ribs" in our specimens the number of "ribs" varied and were so weak that the jaws appeared smooth.

Hedley's illustration of the radula showed the central portion only and was so generalized that little can be ascertained from it. He records 95 teeth per row; our count varied from 85 to 145 per row. The teeth are arranged in straight rows and are similar to those of *Rhynchotrochus kubaryi* (Möllendorff) and *weigmanni* (v. Martens) as well as *Megalacron klaarwateri* (Rensch).

The reproductive system of *L. brumeriensis* appears closest to *Rhynchotrochus*. Of the species in that genus for which the anatomy is known, it is most similar to *R. kubaryi* (Möllendorff) and *taylorianus* (Adams and Reeve). The ovotestis appears to have 3 indistinct lobes. The albumen gland is very large and solid in all three specimens. The prostate and uterus are long and convoluted, the loops being held by strong mesenteries which had to be torn before specimens could be straightened out somewhat for illustration. The spermatheca varied as shown in figures 1 and 2. In its normal position it is closely bound to the uterus and prostate, lying mainly on the dorsal surface with the head reaching nearly to the albumen gland. It was particularly conspicuous in the specimen illustrated in fig. 1. Here the greatly swollen spermatheca completely covered the uterus and prostate and was the first organ visible on making a median dorsal incision in the body wall. The great differences shown here are without doubt a reflection of a different phase in the reproductive cycle. The penial apparatus has a long epiphallus but lacks a flagellum. The vas deferens which lies close against the oviduct and the vagina, enters the epiphallus terminally. The epiphallus, in the specimens dissected, was always coiled in the angle between the penis and the vagina, the anterior portion being bound to the outer wall of the penial sheath. The upper portion of

the penial sheath is thick walled, muscular and with strong pilasters. This is similar to the situation in *Megalacron klaarwateri* but the reverse of that in *kubaryi* in which the lower portion is the more muscular.

In the semi-diagrammatic illustrations the various organs have been separated and oriented in the same general way as in our previous reports (1964, 1966) for ease in comparison. As mentioned in previous reports, no definite statements can be made as to the close relationships of the various genera in the Papuininae. Certain patterns are beginning



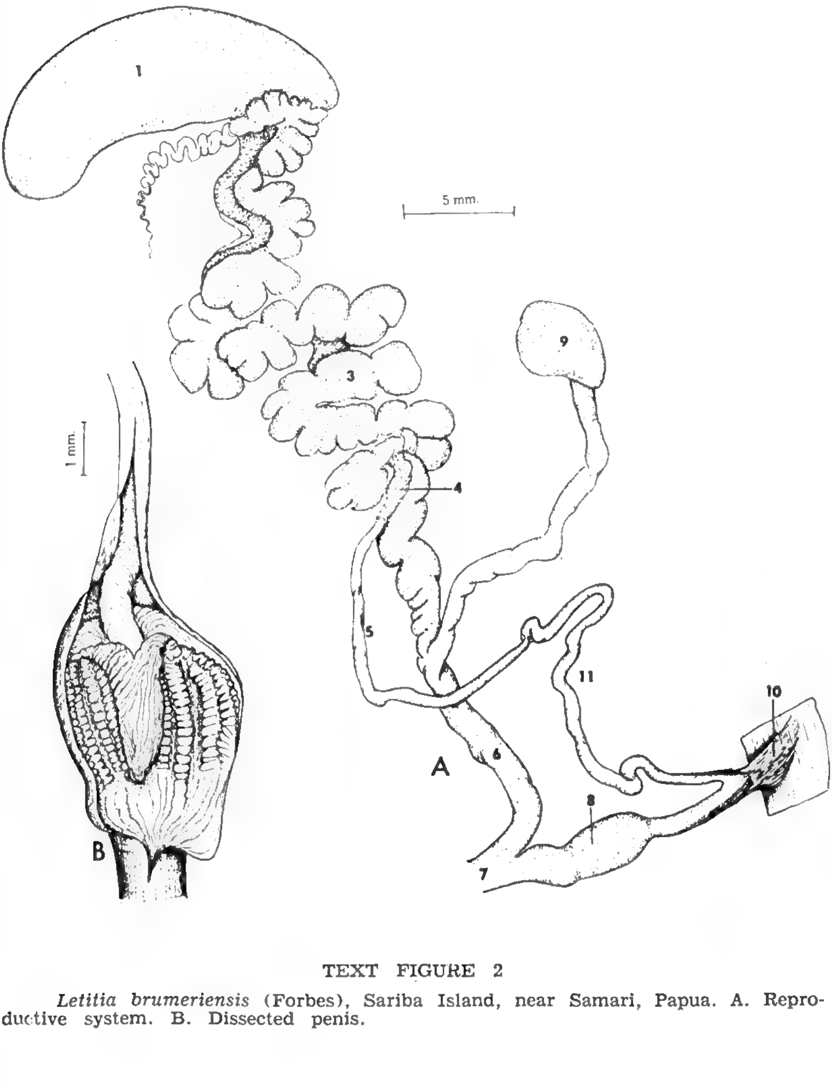
TEXT FIGURE 1

Letitia brumeriensis (Forbes),
Sariba Island, near Samari, Papua

A. Jaw with distinct lines but not raised ribs; B. Radular teeth; C. Reproductive system.

Labelling for the reproductive system: 1. Albumen gland. 2. Ovotestis. 3. Uterus. 4. Prostate. 5. Vas deferens. 6. Vagina. 7. Atrium. 8. Penis. 9. Spermatheca. 10. Penial retractor. 11. Epiphallus.

to appear however, based on the arrangement of the teeth on the radular ribbon, the presence or absence of a flagellum, the type of epiphallus, the spermatheca and certain shell characters. The anatomy of other species in this and other groups must be studied in order to evaluate properly these differences and to interpret their meaning from an evolutionary point of view.



TEXT FIGURE 2

Letitia brumeriensis (Forbes), Sariba Island, near Samari, Papua. A. Reproductive system. B. Dissected penis.

Subgenus *LETITIA* Iredale

Letitia Iredale 1941, *Aust Zool.*, 10:78 (type species, *Helix brumeriensis* Forbes, original designation).

Zenolina Iredale 1941, *Aust. Zool.*, 10:82 (type species, *Helix chapmani* Cox, original designation).

Shells white, sometimes faintly mottled and with the lip colored brown or purplish black; some species have the edge of the lip reddish orange. Shape globose to subextended. Sculpture consisting of fine, irregular, beaded spiral striae or irregular microscopic, anastomosing, wrinkles which are arranged obliquely.

Letitia (Letitia) brumeriensis (Forbes)

Plate 3 fig. 1-5, 7; text fig. 1-2.

Helix brumeriensis Forbes 1852, [in] *Narrative of the Voyage of the* H.M.S. *Rattlesnake,* London, 2:375, pl. 2, fig. 1a-b (Brumer Island, S.E. Coast of New Guinea). [Holotype, BMNH 51.11.24.3]

Geotrochus brumeriensis albolabris Hedley 1891, *Proc. Linn. Soc. N.S.W.*, (2)6:89 (Mita, Milne Bay, Papua [New Guinea]). [Holotype, AM C. 62662.]

Letitia adjuncta Iredale 1941, *Aust. Zool.*, 10:78, pl. 4, fig. 8 (Port Glasgow, and Millport Harbour, Papua [New Guinea]). [Holotype, AM C. 62659 Millport Harbour, on label].

Letitia interrupta Iredale 1941, *Aust. Zool.*, 10:79, pl. 4, fig. 9 (Milne Bay, Papua [New Guinea]). [Holotype, AM C. 62660.]

Description: Shell subglobose, imperforate, minutely sculptured and reaching 37.5 mm. in greater diameter. Color white with occasional specimens having the early whorls pinkish white to purplish white. Lip generally a dark purple-brown; rarely white. Parietal area white to slightly purplish in color and, in some specimens, with a slightly raised ridge of dark purple-brown connecting the upper and lower lip. Color behind the reflected lip, smokey or mottled in appearance as the dark coloration shows through. Whorls 4½ and convex. Spire moderately extended and produced at an angle of about 90°. Aperture subelliptical and cast at an angle of about 30° from the base. Outer lip reflected and broadened over the umbilical area. Parietal wall thinly glazed. Columella short and arched. Suture slightly indented. Sculpture consisting of irregular, often indistinct, microscopic and beaded spiral threads. Periostracum usually deciduous but, when present, is very thin and yellowish. Partial wearing of the periostracum may give the shell a mottled appearance. Protoconch, 1½ whorls, smooth and generally white.

PLATE 3

Fig. 1. *Helix brumeriensis* Forbes. Brumer Island, SE Coast of New Guinea. Holotype, BMNH 51.11.24.3 [=*Letitia brumeriensis* (Forbes)] (Nat. size).

Fig. 2-3. *Letitia brumeriensis* (Forbes). Huhuna, East Cape, Eastern Division, Papua, MCZ 111147 (1.5X).

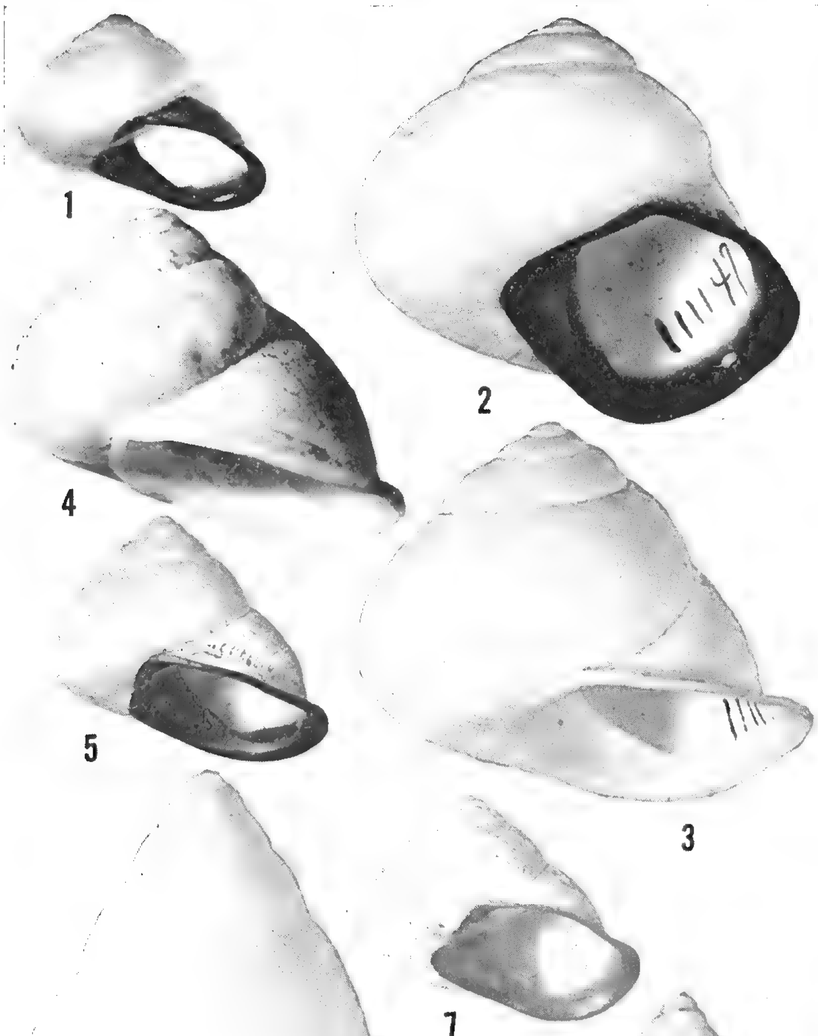
Fig. 4. *Geotrochus brumeriensis albolabris* Hedley. Mita, Milne Bay, Papua. Holotype, AM C.62662 [=*Letitia brumeriensis* (Forbes)] (1.5X).

Fig. 5. *Letitia adjuncta* Iredale. Millport Harbour, Eastern Division, Papua. Holotype, AM C.62659 [=*Letitia brumeriensis* (Forbes)] (Nat. size).

Fig. 6. *Letitia chapmani* Cox, Rossel Island, Louisiade Islands. MCZ 123689 (1.5X).

Fig. 7. *Letitia interrupta* Iredale. Mita, Milne Bay, Papua. Holotype AM C.62660 [=*Letitia brumeriensis* (Forbes)] (Nat. size).

Fig. 8. *Helix chapmani* (Cox). Rossel Island, Louisiade Islands. Holotype AM C.62669 [=*Letitia chapmani* (Cox)] (Nat. size).


1
2
4
5
3
6
7
8

Measurements

Height mm.	Width mm.	
28	32.5	Lectotype, *Geotrochus brumeriensis albolabris* Hedley
31	34.5	Holotype of *Letitia adjuncta* Iredale
28	35.5	Holotype of *Letitia interrupta* Iredale
30	36	Rogeia Id., Samarai, Papua, New Guinea
31	37.5	Basilaki Id., Eastern Div., Papua
31	33.5	Basilaki Id., Eastern Div., Papua
30	33.5	Basilaki Id., Eastern Div., Papua
22.5	29	Basilaki Id., Eastern Div., Papua
23	26.5	Basilaki Id., Eastern Div., Papua
26.5	29.5	Brumer Id., Papua
23	28.5	Brumer Id., Papua

Remarks: This species is confined to the eastern end of Papua. The subspecies *L. b. comriei*, which is restricted to the Louisiade Islands, differs from the typical form by being smaller, having a more irregular interlacing sculpture super-imposed on the basic microscopic, beaded, spiral threads. From *L. chapmani*, a species limited to Rossel Island in the Louisiades, it differs by being less attenuate and in having the lip uniformly colored. *Letitia chilochroa* differs from *brumeriensis* in having a rounded peripheral keel, in being constricted behind the lip, and in having the lip margined with red.

Range: From East Cape, Milne Bay to Samarai, and west to the vicinity of Millport Harbor, Papua, New Guinea.

Specimens examined: *New Guinea*: *Papua*: Huhuna, East Cape, Milne Bay (MCZ; ANSP; UM); Milne Bay (USNM; NMV; AM; MM); Samarai (MCZ); Rogeia Island, Samarai (NMV); Sariba Island, Samarai (AM); Sideia Island, 15 miles E. of Samarai (NMV); Basilaki Island, 25 mi. E. of Samarai (MCZ); Brumer Island, 25 mi. W of Samarai (MCZ; ANSP); Lawes Bay, 43 mi. W of Samarai (MCZ); Kau Kau Bay, 50 mi. W. of Fife Bay, Eastern Division (MCZ); Orangerie Bay, about 60 mi. W of Samarai (NMV); Baibara Island, Orangerie Bay (NMV); Port Glasgow (AM); Millport Harbor (10°21'S; 149°29'E) [=Losoa Dudu] (BMNH; USNM); Mailu Id., near Millport Harbor (MCZ).

Letitia (Letitia) brumeriensis comriei (Adams & Angas)

Plate 4 fig. 1-11

Helix comriei Adams and Angas 1876, *Proc. Zool. Soc. London*, p. 489, pl. 47, figs. 4-5 (Shore of Huon Gulf, Southeast New Guinea). [Holotype[1], may be in the Hancock Museum, Newcastle, England.]

Letitia brumeriensis moturina Iredale 1941, *Aust. Zool.*, 10:79, pl. 4, fig. 10 (Moturina Island, Calvados Chain, Louisiade Archipelago). [Holotype, AM C. 62661.]

Letitia maria Iredale 1941, *Aust. Zool.*, 10:79, pl. 4, fig. 1 (Panapompom Id., Deboyne Group, Louisiades). [Holotype, AM C. 62663.]

Letitia degener Iredale 1941, *Aust. Zool.*, 10:79, pl. 4, fig. 13 (Tube Tube Id., Engineer Group, Louisiade Archipelago). [Holotype, AM C. 62664.]

[1] See Hedley 1913, *Proc. Linn. Soc. N.S.W.*, 38:258-261.

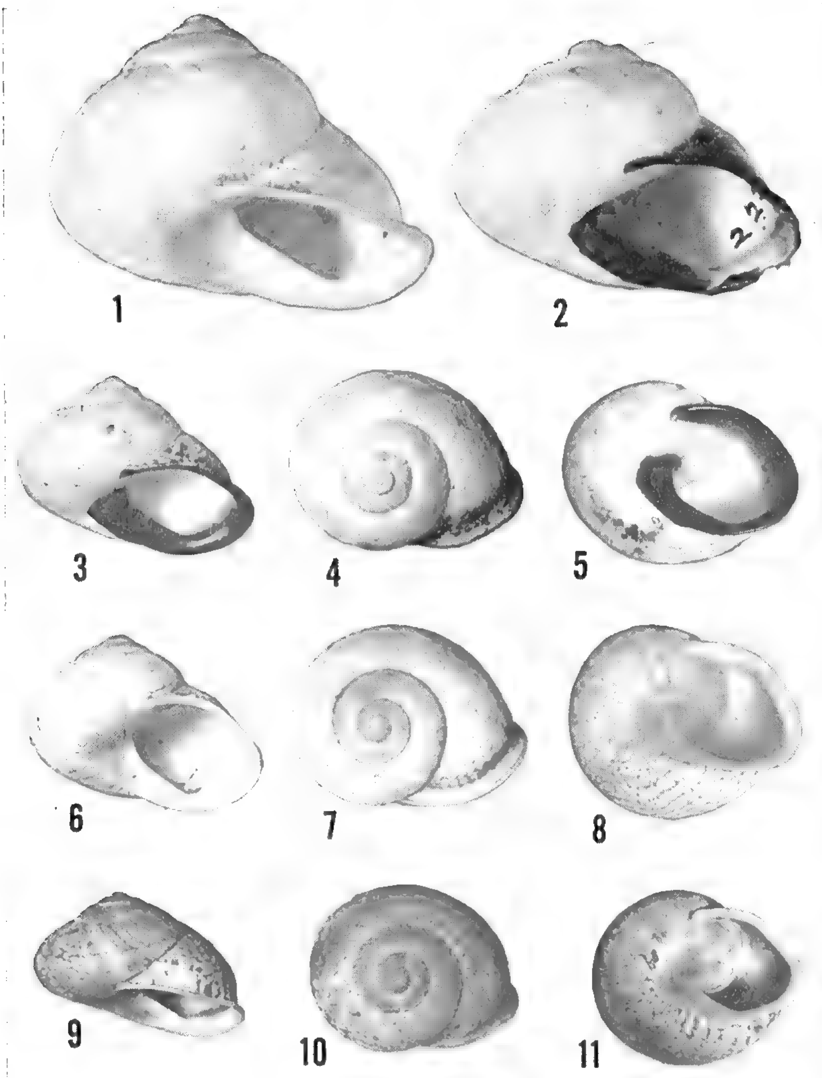


PLATE 4

Fig. 1. *Letitia brumeriensis comriei* (Adams and Angas). Panapompom Island, Deboyne Group, Louisiade Islands. MCZ 225241 (1.5X).

Fig. 2. *Letitia brumeriensis comriei* (Adams and Angas). Brooker or Utian Island, Calvados Group, Louisiade Islands. MCZ 225240 (1.5X).

Fig. 3-5. *Letitia brumeriensis moturina* Iredale. Moturina Island, Calvados Group, Louisiade Islands. Holotype AM C.62661 [=*Letitia brumeriensis comriei* (Adams and Angas)] (Nat. size).

Fig. 6-8. *Letitia maria* Iredale. Panapompom Island, Deboyne Group, Louisiade Islands. Holotype AM C.62663 [= *Letitia brumeriensis comriei* (Adams and Angas)] (Nat. size).

Fig. 9-11. *Letitia degener* Iredale. Tube Tube Island, Engineer Group, Louisiade Islands. Holotype AM C.62664 [=*Letitia brumeriensis comriei* (Adams and Angas)] (Nat. size).

Description: Shell subglobose, imperforate, smooth and reaching 30 mm. (1¼ inches) in greater diameter. Ground color a chalky white, occasionally showing flecks of remaining yellowish periostracum. Lip white or brownish black. Whorls 4½, convex and usually with a broadly rounded keel. Spire moderately extended and produced at an angle of about 90°. Aperture subelliptical and cast at an angle of about 40° from the base. Outer lip reflected and broadened over the umbilical area. Parietal wall thinly glazed. Columella short and arched. Suture slightly indented. Sculpture consisting of irregular, often indistinct microscopic spiral beaded threads. Periostracum usually deciduous and when present is very thin and yellowish. The partial wearing of the periostracum may give the shells a mottled appearance. Protoconch, 1½ whorls, smooth and white in color.

Measurements

Height mm.	Width mm.	
21	27	Holotype, *Helix comriei* Adams and Angas
22.5	30	Panaete Id., Louisiade Ids.
22	27.5	Panaete Id., Louisiade Ids.
21	27	Panapompom Id., Louisiade Ids.
18	24.5	Tube Tube Id., Louisiade Ids.

Remarks: This subspecies differs only slightly from the typical form, mainly in being smaller, but even here there is an overlap in size. Specimens of the subspecies, however, show a smaller range of variation in size than *L. brumeriensis, s.s.* Specimens of *L. b. comriei* are characterized by having a broad, rounded keel at the whorl periphery which is not evident in the typical form. On the basis of the material studied it would appear that the white lipped form is the more common in *L. b. comriei,* while the reverse is true for *L. brumeriensis.* Additional collecting, of course, may change this.

The type locality "Shores of Huon Gulf, Southeast New Guinea" is probably in error as we have seen no specimens from the mainland of New Guinea. We here restrict the type locality to Tube Tube Island [Slade Island], Engineer Group, Louisiade Islands, as shells from this island closely approximate the figure of Adams and Angas.

See also *Remarks* under *Letitia brumeriensis.*

Range: From islands in the Engineer Group, east through the Calvados Group, Louisiade Islands.

Specimens examined: *Louisiade Islands*: Tube Tube [=Tule Tulu or Slade Id.] (AM); Kuriva [Kirivi or Watts] Id., both Engineer Group (AM; MCZ; USNM; CM); Panaete Id. [Panniet] (AM) and Panapompom Id., both Deboyne Ids. (R. Jackson; MCZ; AM); Moturina Id. (AM) and Brooker Id. [Utian Id.], both Calvados Chain (AM; MCZ).

Letitia (*Letitia*) *chapmani* (Cox)

Plate 3 fig. 6, 8.

Helix (*Geotrochus*) *chapmani* Cox 1879, *Proc. Linn. Soc. N.S.W.*, 4:115, pl. 16, fig. 2 (Rossel Id., Louisiade Islands); Cox, 1888, *Proc. Linn. Soc. N.S.W.*, (2)2:1063, pl. 21, fig. 10-11. [Holotype, AM C. 62669.]

Helix (*Acavus*) *coraliolabris* Smith 1887, *Ann. Mag. Nat. Hist.*, (5), 19: 419, pl. 15, fig. 4 (Russell [Rossel] Island, New Guinea [Louisiade Islands]). [Holotype, BMNH?.]

Description: Shell extended, conic, imperforate, minutely sculptured and reaching 34 mm. in greater diameter. Color a uniform white, the lip white, light purple or brown, with the outer edge an orange-brown. Whorls 5¼ to 5¾, moderately convex, and with a slight keel on the body whorl. Spire extended and produced at an angle of 60° to 75°. Aperture subelliptical, not descending, and cast at an angle of 30° from the base. Outer lip reflected, slightly rostrate and broadened over the umbilical area; parietal wall thinly glazed. The brown coloration rarely extends over the parietal area. Sculpture consisting of very fine wrinkles, generally arranged obliquely and becoming somewhat coarser below the whorl periphery. Periostracum exceedingly thin, pale yellow and deciduous. Protoconch, 1½ whorls, smooth and white.

Measurements

Height mm.	Width mm.	
33.5	30	Holotype, *Helix chapmani* Cox
34	32	Holotype, *Helix coraliolabris* Smith
38	33	Rossel Island, Louisiade Ids.
36.5	34	Rossel Island, Louisiade Ids.
35	31	Rossel Island, Louisiade Ids.
33	31.5	Rossel Island, Louisiade Ids.

Remarks: So far as known, this species is limited to Rossel Island, the easternmost island in the Louisiade Islands. *L. chapmani* is the only attenuated species in the genus *Letitia*, all of the others being globose or depressed globose.

See also *Remarks* under *L. brumeriensis.*

Range and specimens examined: *Louisiade Islands*: Rossel Island (AM; MCZ; USNM; ANSP; UM).

Letitia (*Letitia*) *chilochroa* (DaCosta)

Plate 5 fig. 1-3.

Papuina chilochroa DaCosta 1899, *Proc. Malac. Soc. Lond.,* 3:306, text fig. 6 (British New Guinea [Papua]). [Holotype, BMNH 1907.11.21.71.]

Description: Shell subglobose, imperforate, minutely sculptured and reaching 34 mm. in greater diameter. Color a uniform creamy white. Lip white or chocolate-brown, the outer edge orange. Whorls 4½ and moderately convex. Spire moderately extended and produced at an angle of 94° to 95°. The body whorl with a rounded peripheral keel. Aperture subelliptical, descending, constricted behind the lip and cast at an angle of 40° to 45° from the base. Outer lip reflected and broadened over the umbilical area; parietal wall thinly glazed, white or brown in color. Columella very short and slightly angled. Suture slightly indented. Sculpture irregular, consisting of fine wrinkles generally arranged obliquely. Periostracum very thin and deciduous. Protoconch, 1½ whorls, smooth and white.

Measurements

Height mm.	Width mm.	
26	34	Holotype
24	33	Mt. Victoria, Central Division, Papua
23	31	Iokea, Gulf Division, Papua

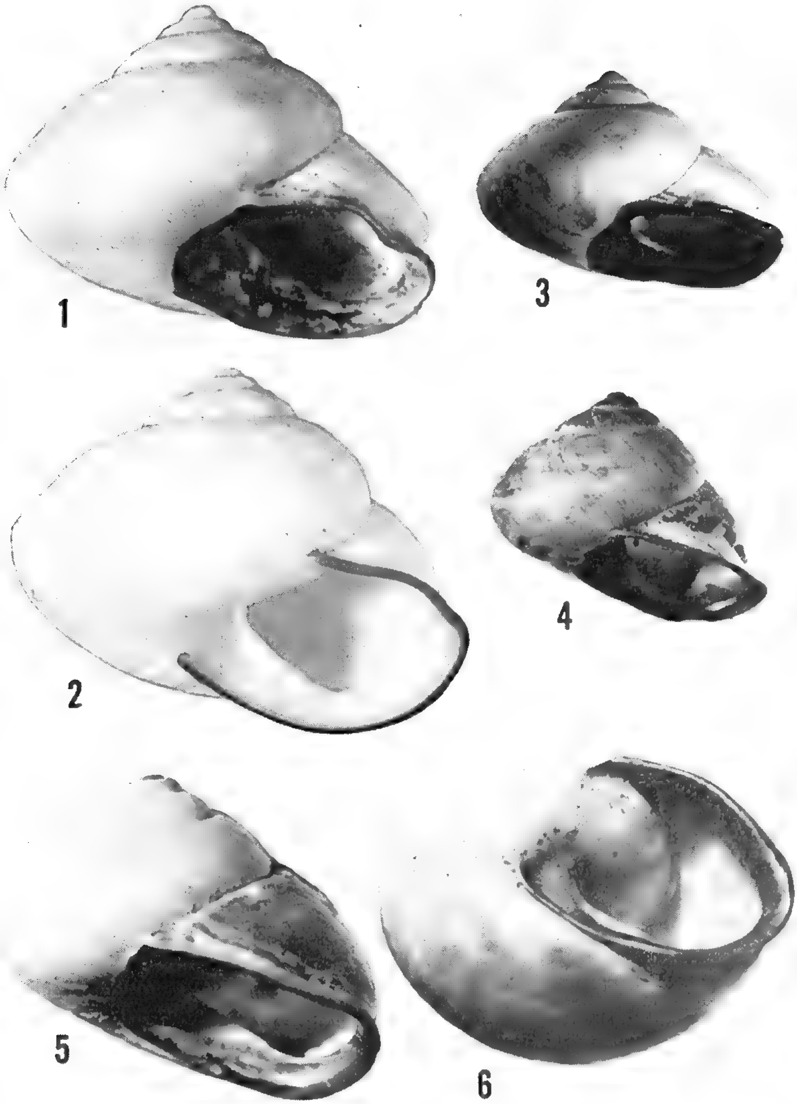


PLATE 5

Fig. 1. *Letitia chilochroa* (DaCosta). Iokea, Gulf Division, Papua. MCZ 248651 (1.5X).
Fig. 2. *Letitia chilochroa* (DaCosta). Mt. Victoria, Central Division, Papua. UM 58665 (1.5X).
Fig. 3. *Papuina chilochroa* DaCosta. British New Guinea. Holotype BMNH 1907.11.21.71 (Nat. size).
Fig. 4. *Papuina zeno subglobosa* Fulton. Port Moresby, British New Guinea. Holotype BMNH 1902.5.28.31 [=*Letitia zeno* (Brazier)] (Nat. size).
Fig. 5-6. *Helix* (*Geotrochus*) *zeno* Brazier. Hall Sound, New Guinea. Lectotype, Macleay Mus. Univ. of Sydney, Australia no. A62 [=*Letitia zeno* (Brazier)] (1.5X).

Remarks: The sharply descending aperture and the restriction behind the lip separate this species from the others in *Letitia, s.s.* It must be a very rare species as we have seen but two specimens.

See also *Remarks* under *L. brumeriensis.*

Range and specimens examined: *Papua*: Iokea, Gulf Division (MCZ); Mt. Victoria, Central Division (UM).

Subgenus *SACCOLETITIA* Iredale

Saccoletitia Iredale 1941, *Aust. Zool.* 10:79 (type species, *Helix (Geotrochus) zeno* Brazier, original designation).

Caroletitia Iredale 1941, *Aust. Zool.*, 10:80 (type species, *Helix diomedes* Brazier, original designation).

Shells of this subgenus are characterized by the brownish purple lip, the dull grayish white periostracum and the numerous, irregular, spiral bands of a dark, brownish purple. The whorls may be rounded or rather acutely keeled. A well formed papuinoid notch is present in some species.

Letitia (*Saccoletitia*) *zeno* (Brazier)

Plate 5 fig. 4-6; Plate 6 fig. 5

Helix (*Geotrochus*) *zeno* Brazier 1876, *Proc. Linn. Soc. N.S.W.*, 1:107 (Hall Sound, New Guinea). [Lectotype, here selected, Macleay Museum, University of Sydney, Sydney, Australia no. A.62.]

Geotrochus zeus 'Brazier' Smith 1893, *The Conchologist,* 2:108 [error for *zeno* Brazier].

Papuina zeno subglobosa Fulton 1902, *Ann. Mag. Nat. Hist.* (7), 9:184 (Port Moresby, British New Guinea). [Holotype BMNH 1902.5.28.31.]

Description: Shell subglobose, imperforate, smooth and reaching 40 mm. (about 1½ inches) in greater diameter. Ground color reddish brown with a grayish white periostracum and with 6 to 7 interrupted spiral bands of reddish brown showing through. In specimens where the periostracum has been completely worn away there are corresponding bands of white and reddish brown in the structure of the shell. Lip purplish black with the parietal area and columella brownish purple. Whorls 4½ and convex. Spire moderately extended and produced at an angle of 87° to 98°. Aperture subelliptical, slightly descending and cast at an angle of about 28° from the base. Outer lip reflected and broadened over the umbilical area. Parietal wall rather heavily glazed. Columella broad and arched. Suture slightly indented. Sculpture consisting of irregular microscopic, often indistinct, spiral beaded threads. Periostracum opaque. Protoconch, 1½ whorls, smooth and a dark purple-brown in color.

Measurements

Height mm.	Width mm.	
24	29	Paratype of *Papuina zeno subglobosa* Fulton
33	40	Manvagolo, Papua
31	38.5	Orokolo, Gulf Division, Papua
29	37	Rigo, Central Division, Papua
26	34	Orokolo
25	34	Rigo

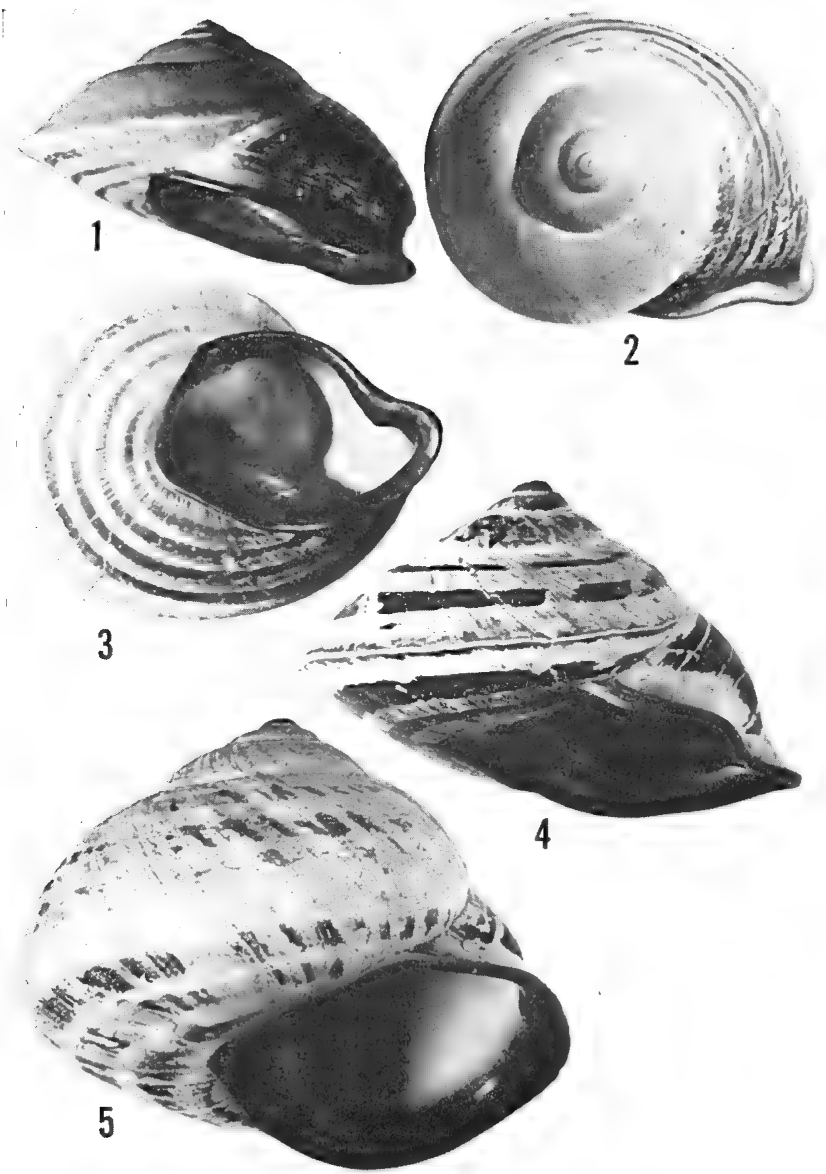


PLATE 6

Fig. 1-3. *Papuina secans* Hedley. Mt. Maneao, Papua. Holotype AM C.942 [=*Letitia secans* (Hedley)] (1.2X).

Fig. 4. *Letitia secans* (Hedley). Mt. Simpson, Northeastern Division, Papua MCZ 225331 (1.8X).

Fig. 5. *Letitia zeno* (Brazier). Merigeda, 10 mi E of Port Moresby, Papua. MCZ 123685 (1.8X).

Remarks: This is a very distinctive species with its peculiar type of coloration. The form *subglobosa* described by Fulton differs only in being a little smaller, and even here it grades into the typical form. The morphology of the shell of *zeno* is very similar to that of *L. brumeriensis*, differing only in its type of coloration, though occasional specimens of *brumeriensis* do show traces of banding. It is close to *L. latiaxis* Smith.

Range: From Orokolo, Gulf Division, southeast to Rigo, Central Division, Papua, New Guinea.

Specimens examined: *Papua*: Orokolo, Gulf Division; Hall Sound, about 60 mi. NW of Port Moresby (both AM); Laloki River, about 12 mi. NE of Port Moresby (AMNH; UM; ANSP); Manvagolo, 25 mi. ENE of Port Moresby; Mount Astrolabe, about 15 mi. E of Port Moresby; near Port Moresby, Astrolabe Range (all AM); Rouna Falls, about 20 mi. E of Port Moresby [rain forest] (NMV); Inland from Port Moresby (MCZ); Port Moresby (USNM; ANSP; AM; UM); Rigo, about 40 mi. SE of Port Moresby (MCZ; AM); Merigeda, about 10 mi. E of Port Moresby [9°31'S; 147°18'E] (MCZ; R. Jackson).

Letitia (*Saccolentia*) *secans* (Hedley)

Plate 6 fig. 1-4.

Papuina secans Hedley 1894, *Proc. Linn. Soc. N.S.W.*, (2), 9:389, pl. 25, fig. 8, 9 (Mount Maneao [9°50'S; 149°20'E], British New Guinea). [Holotype, AM C. 942.]

Description: Shell subglobose to depressed, imperforate, acutely keeled, smooth and reaching 40 mm. in greater diameter. Ground color dark mahogany-brown with a grayish white periostracum with 8 or 9 spiral bands of mahogany-brown showing through the periostracum. Lip chocolate-brown with the parietal area of adults usually covered with a glaze of the same color. Whorls 4½, convex and acutely keeled. Spire somewhat depressed, obtuse and produced at an angle of about 100° to 105°. Aperture subquadrate, rather sharply descending and produced at an angle of 30° from the base. Outer lip reflected and broadened over the umbilical area, with a well developed papuinoid notch, and with a tooth at the deepest portion of the notch. On the outer margin of the lip there is a depression opposite this tooth. Columella broad and arched. Suture slightly indented. Sculpture consisting of irregular, microscopic and somewhat wavy spiral beaded threads. Periostracum opaque. Protoconch 1½ whorls, smooth and dark purplish in color.

Measurements

Height mm.	Width mm.	
26.5	43	Holotype
29	39	Collingwood Bay, NE Div., Papua
26.5	40	Collingwood Bay, NE Div., Papua
24	35	Mt. Simpson, NE Div., Papua

Remarks: In shape and color pattern this species is close to *L. latiaxis* Smith but differs from it by the presence of the tooth on the parietal lip at the low point of the well developed papuinoid notch.

Range: Based on the small amount of material now available, this species appears to be restricted to the area around Collingwood Bay in the Northeastern Division, Papua.

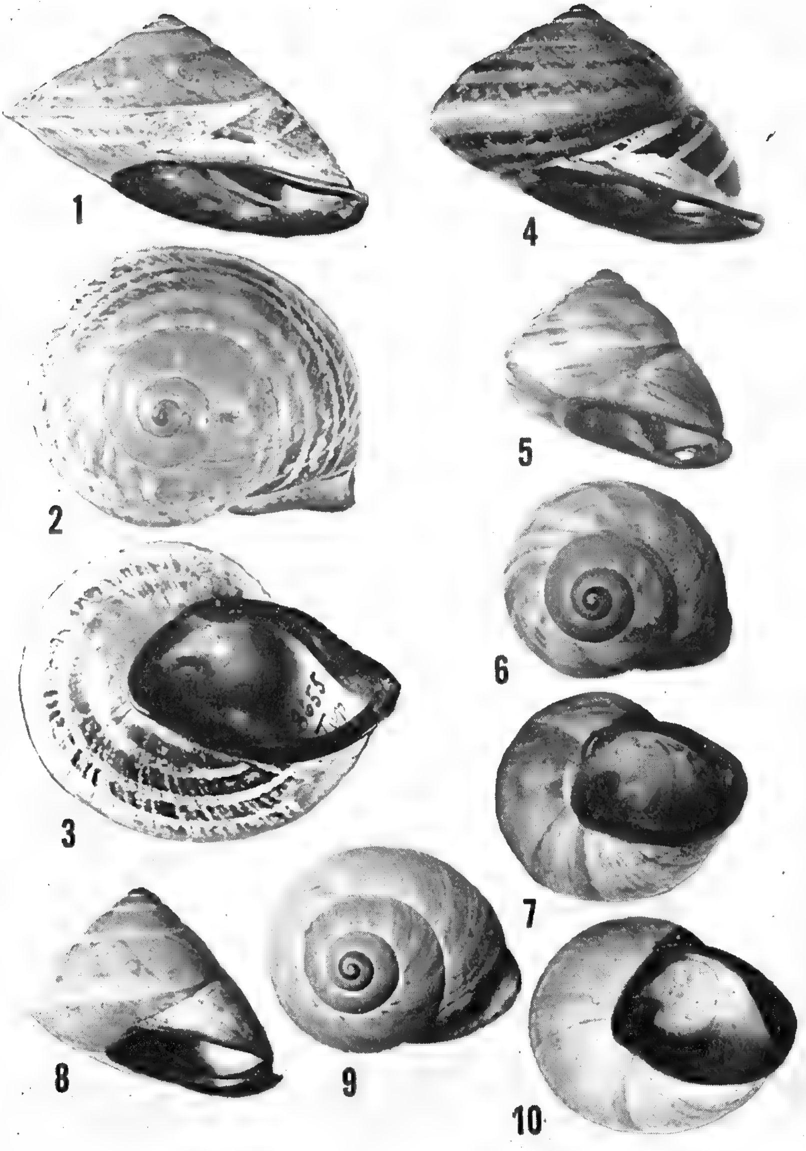


PLATE 7

Fig. 1-3. *Papuina linterae* v. Mollendorf. New Guinea. Holotype. SMF 8655 [=*Letitia latiaxis* (Smith)] (Nat. size).

Fig. 4. *Helix (Geotrochus) latiaxis* Smith. Foot of Owen Stanley Range, Papua. Holotype. BMNH 85.5.19.3 [=*Letitia latiaxis* (Smith)] (Nat. size).

Fig. 5-7. *Caroletitia vilia* Iredale. Vilirupu, Eastern Division, Papua. Holotype. AM C.58235 [=*Letitia diomedes* (Brazier)] (Nat. size).

Fig. 8-10. *Helix diomedes* Brazier. Coutance Island, Eastern Division, Papua. Holotype. AM C.2665 [=*Letitia diomedes* (Brazier)] (Nat. size).

Specimens examined: *Papua*: Collingwood Bay (MCZ; MM; UM); Mt. Simpson (MCZ; A. d'Atillio); Mount Maneao [? Manead], all Northeast Division (AM).

Letitia (*Saccoletitia*) *diomedes* (Brazier)

Plate 7 fig. 5-10.

Helix diomedes Brazier 1877, *Proc. Linn. Soc. N.S.W.* 2:121 (not Brumer Id., Louisiade Archipelago as given by Brazier, but Coutance Island, Papua [10°15'S; 148°10'E] *fide* Brazier *in* Tapparone-Canefri 1883, *Ann. Mus. Stor. Nat. Genova,* 19:122, pl. 3, fig. 12). [Holotype, AM C.62665.]

Geotrochus diomedes Brazier. Hedley 1891, *Proc. Linn. Soc. N.S.W.*, 6:89.

Caroletitia vilia Iredale 1941, *Aust. Zool.*, 10:80, pl. 4, fig. 14 (Vilirupu [10°6'S; 148°10'E], Eastern Division, Papua). [Holotype, AM C.58235.]

Description: Shell trochoid in shape, imperforate, acutely keeled, smooth and reaching 39 mm. in greater diameter. Ground color a medium pinkish brown with a grayish white periostracum and 8 to 9 indistinct spiral bands of the base color showing through the periostracum. Lip chocolate with the parietal area covered by a heavy glaze of the same color. Whorls 4½, flat-sided, and acutely keeled. Spire moderately extended and produced at an angle of about 80° to 90°. Aperture subquadrate, descending and cast at an angle of about 32° from the base. Outer lip reflected and broadened over the umbilical area and with a slight papuinoid notch. Parietal wall rather heavily glazed. Columella broad and arched. Suture very slightly indented. Sculpture consisting of irregular microscopic and somewhat wavy, spiral, beaded threads. Periostracum opaque. Protoconch, 1½ whorls, smooth and a dark purplish brown in color.

Measurements

Height mm.	Width mm.	
26	31.5	Holotype
28.5	33.2	Paratype
27.5	35	Paratype
27	39	Cloudy Bay, Papua, New Guinea

Remarks: This species is readily distinguished from *latiaxis* and *secans* by its trochoid shape, higher spire, straight-sided whorls and in having the papuinoid notch only slightly indicated.

Range: So far as known this species has a very limited distribution. We have seen material from two localities which are only 35 miles apart.

Specimens examined: *Papua*: Coutance Island [10°15'S; 148°10'E] (ANSP; AM); Cloudy Bay (AM).

Letitia (*Saccoletitia*) *latiaxis* (Smith)

Plate 7 fig. 1-4.

Helix latiaxis Smith 1883, *Ann. Mag. Nat. Hist.* (5)11:191 (d'Entrecasteaux Ids.); Smith 1887, *Ibid.*, (5)19:420, pl. 15, fig. 7 (locality corrected to Foot of Owen Stanley Mountains, Papua). [Holotype, BMNH 87.5.19.3.]

Papuina linterae von Möllendorf 1897, *Nachrbl. Dtsch. Malakozöol. Ges.*, 29:30 (New Guinea). [Holotype, Senckenberg Mus., Frankfurt 8655.]

Description: Shell subglobose to depressed, imperforate, acutely keeled, smooth and reaching 42 mm. in greater diameter. Ground color dark, mahogany-brown with a grayish white periostracum. There are 8 or 9 spiral bands of mahogany-brown showing through the periostracum. Lip purplish black with the parietal area usually covered by a heavy glaze of the same color. Whorls 4½, convex and acutely keeled. Spire somewhat depressed, obtuse and produced at an angle of about 95° to 100°. Aperture subquadrate, rather sharply descending and cast at an angle of about 30° from the base. Outer lip reflected, broadened over the umbilical area, and with a slight papuinoid notch. Parietal wall rather heavily glazed. Columella broad and arched. Suture slightly indented. Sculpture consisting of irregular microscopic and somewhat wavy spiral beaded threads. Periostracum opaque. Protoconch, 1½ whorls, smooth and a dark purplish brown in color.

Measurements

Height mm.	Width mm.	
28	38	Holotype, *Helix latiaxis* Smith
24	39	Astrolabe Range, near Port Moresby, Papua, New Guinea

Remarks: *L. latiaxis* appears to be rather closely related to *diomedes*, differing by being larger and in having a more descending aperture.

This species has been considered a synonym of *L. zeno* Brazier, but in our opinion it is a good species. It differs from *zeno* by its more conical spire, by its rather acute subperipheral keel, a greater breadth of the lip at the columellar area and its more descending aperture.

Range and specimens examined: *Papua*: Astrolabe Range, near Port Moresby (AM); Foot of Owen Stanley Range (BMNH); Cape Rodney, Eastern Div. (MCZ).

REFERENCES

CLENCH, W. J., and R. D. TURNER, 1959. Two new genera of land molluscs (Papuininae) from the central highlands of New Guinea. *J. Malac. Soc. Aust.*, 3:4-9.

CLENCH, W. J., and R. D. TURNER, 1962. Monographs of the genera *Papustyla, Forcartia* and *Meliobba* (Papuininae: Camaenidae). *J. Malac. Soc. Aust.*, 6:3-33.

CLENCH, W. J., and R. D. TURNER, 1964. Monographs of the genera *Megalacron* and *Rhytidoconcha* (Papuininae: Camaenidae). *J. Malac. Soc. Aust.*, 8:36-71.

CLENCH, W. J. and R. D. TURNER, 1966. Monograph of the Genus *Rhynchotrochus* (Papuininae: Camaenidae). *J. Malac. Soc. Aust.*, 9:59-95.

HEDLEY, C., 1891. The Land Molluscan Fauna of British New Guinea. *Proc. Linn. Soc. N.S.W.* (2), 6:67-116, pl. 9-12 bis; ibid. 1892, (2) 6:685-698, pl. 38-42.

IREDALE, T., 1941. A basic list of the land Mollusca of Papua. *Aust. Zool.*, 10:51-94, pls. 3-4.

JUTTING, T. VAN B., 1933. Non-marine Mollusca from Dutch North New Guinea including an annotated list of the species of Papuina. *Nova Guinea*, 17:1-80.

PILSBRY, H. A., 1891. *Manual of Conchology*, (2), 7:3-81.

ZILCH, A., 1960. Die Typen und Typoide des Natur-Museums Senckenberg. *Arch. Molluskenk.*, 89:193-202.

JOYCE ALLAN (1896-1966)

OBITUARY, BIBLIOGRAPHY AND INDEX OF HER NEW SCIENTIFIC NAMES

By

GILBERT P. WHITLEY*

Plate 8

The death of Miss Joyce K. Allan, after a long illness on August 31st, 1966, removed from our Society our first Patroness and a conchologist and artist of distinction. In private life she was Mrs. H. W. Kirkpatrick (*née* Catherine Mabel Joyce Allan) but she signed her scientific articles and drawings Joyce K. Allan. She was the daughter of the late J. Stuart Allan of Wellington, New Zealand, a well known artist, and a love of drawing was inherent in Miss Allan who was born in Sydney on the 8th April, 1896 and educated at Fort Street Girls' High School. The Australian Museum's conchologist, Charles Hedley, was acquainted with her father and it was arranged that Miss Allan would assist Hedley as a cadet in the Museum, to sort collections and to draw shells to illustrate Hedley's papers. She was thus the first woman member of the scientific staff, being a "temporary assistant" in 1917 and placed on the permanent staff in November, 1920.

Seated before a slate with a Union Jack-like design on it, she would put a spoonful of shell-sand on the centre and, using a camel hair brush, would flick in radial directions the various orders and families of mollusca. Rubbish would be discarded and the residue again sorted into genera and species, labelled, boxed and placed in cabinets. She illustrated some of the Victorian species of "*Bullinus*" (=*Physastra* of recent authors) for Hedley's paper on them in the *Records of the Australian Museum*, 1917, and in 1919, some of her drawings illustrated Hedley's *Wild Animals of the World*, a popular guide to the then infant Taronga Zoological Park. In subsequent years she was to draw probably more than 9,000 illustrations of mollusca for conchologists like Hedley, Gabriel, Hull and Iredale, to say nothing of her own writings. Miss Allan was equally facile in oils, water colour, or black and white drawing (either in line or wash, using lamp-black). In addition to shells she illustrated mammals, fossils, spiders, insects, crustacea, sharks, elasmobranch eggs and fishes for her colleagues. Her drawings appeared in both editions of the *Australian Encyclopaedia* (1925-6 and 1958), the *Australian Junior Encyclopaedia*, the British Museum's *Scientific Report* of the 1928-29 *Great Barrier Reef Expedition*, the *Australian Museum Magazine, Australian Zoologist, Proceedings of the Royal Zoological Society of New South Wales, Victorian Naturalist*, our own *Journal* (the first two numbers of which contained articles by her), her own books and elsewhere.

When Hedley left the Australian Museum in 1924, Miss Allan was in charge of the department of molluscs until Mr. Tom Iredale was appointed conchologist. During World War II, Miss Allan was seconded to the Department of National Emergency Services (1942-1944) as assistant to the Superintendent of Air Raids Precautions. Her lecturing and organizing talents were put to use in A.R.P. training (largely by

* Honorary Associate, The Australian Museum, Sydney.

PLATE 8

Catherine Mabel Joyce Allan (1896-1966)

her screening of 16 mm. films) and in services at Air Force House, Sydney. Returning to the Australian Museum, Miss Allan rose to the position of Assistant Conchologist and was appointed Conchologist (a title later changed to Curator of Molluscs) when Mr. Tom Iredale retired in 1944.

Miss Allan collected in New South Wales, Victoria, Queensland, Lord Howe Island and New Zealand. She rearranged the shell displays in the public gallery of the Australian Museum, wrote newspaper articles and delivered radio broadcasts and popular lectures, and in 1950 her book "Australian Shells" was published, thereby laying the foundation of much of the popularity which shell collecting enjoys nowadays. She attended A.N.Z.A.A.S. congresses in Australia and New Zealand, the Pacific Science Congress in New Zealand in 1949, and in 1953 the International Congress of Zoology in Copenhagen following which she studied shells in the British Museum (Natural History) and in various continental museums.

Miss Allan retired from the Australian Museum in 1956 on medical advice but continued working on shells until prevented by ill-health. She was elected an Honorary Zoologist (later Honorary Associate) of the Australian Museum following her retirement. She is commemorated in the names of several shells (*Allanassa, Coralastele allanae, Rissoina allanae*), a fish (*Microcanthus joyceae*) and an insect (*Scotinophara allanae*).

The following is a list of her scientific papers and articles in chronological sequence which is followed by a list of her new scientific names. All were printed in Sydney unless otherwise stated. Joint authorships are recorded after titles of papers.

BIBLIOGRAPHY

1. The carrier shell.
   Austr. Mus. Mag., 3 (2), April-June 1927, p. 57 & figure.
2. Shell ornamentation.
   Austr. Mus. Mag., 4 (2), April-June 1930, pp. 45-48, 6 figs.
3. Mollusca [Title of MS. only, never published]. By Tom Iredale & J. K. Allan, for proposed Handbook Fauna & Flora of Sydney District.
   Austr. Mus. Ann. Rept. 1930-31 (1931), p. 10.
4. Sea slugs.
   Austr. Mus. Mag., 4 (5), Jan.-Mch. 1931, pp. 156-191, 6 figs.
5. Australian nudibranchs.
   Austr. Zool., 7 (2), Feb. 5, 1932, pp. 87-105, pls. 4-5, text-figs. 1-2.
6. Cowries.
   Austr. Mus. Mag., 4 (9), Jan.-Mch. 1932, pp. 291-297, 9 figs.
7. Snails.
   Austr. Mus. Mag., 4 (10), April 1932, pp. 355-360, 4 figs.
8. A new genus and species of sea-slug, and two new species of sea-hares from Australia.
   Rec. Austr. Mus. 18 (6), April 20, 1932, pp. 314-320, pls. 34-35.
9. Australian sea-slugs.
   Vict. Nat., 49 (5), Sept. 1932, pp. 119-125, coloured pl. 7. Reprinted in *Sydney Harbour Trust Officers' Journal*, 8 (9). 1933, pp. 27-34.
10. Sea-hares.
    Austr. Mus. Mag., 4 (12), Oct.-Dec. 1932, pp. 419-425, 7 figs.
11. Opisthobranchs from Australia.
    Rec. Austr. Mus. 18 (9), Jan. 10, 1933, pp. 443-450, pl. 56.
12. The octopus and its allies.
    Vict. Nat. 49 (10), Feb. 1933, pp. 235-242, pl. 15.
13. Our native slug.
    Austr. Mus. Mag., 5 (1), Jan.-Mch. 1933, pp. 3-6, 3 figs.
14. Shells in the Waterhouse Collection.
    Austr. Mus. Mag., 5 (2), April-June 1933, pp. 39-43 & frontispiece
15. Habits of the Sydney octopus (*Octopus cyaneus*) in captivity. (By A. S. Le Souef & J. K. Allan).
    Austr. Zool., 7 (5), Aug. 22, 1933, pp. 373-376, pl. 20.

16. Egg-cases of sea-snails and sea-slugs.
Vict. Nat., 50, Feb. 1934, pp. 229-235, pl. 39.

17. Tyrian purple, an ancient industry.
Austr. Mus. Mag., 5 (5), Jan.-Mch. 1934, pp. 147-151, 5 figs.

18. Pearl from a freshwater mussel, and notes on the occurrence of pearls.
Vict. Nat. 51 (7), Nov. 1934, pp. 166-169, 2 figs.

19. Silk from shells, an ancient industry.
Austr. Mus. Mag., 5 (7), July-Sept. 1934, pp. 220-223, 4 figs.

20. Australian shells: slit shells and false limpets.
Austr. Mus. Mag., 5 (8), Oct.-Dec. 1934, pp. 277-282, 6 figs.

21. Australian shells: ear shells and wide-mouthed shells.
Austr. Mus. Mag., 5 (9), Jan.-Mch. 1935, pp. 320-324, 5 figs.

22. Australian shells: top, turban, pheasant and dolphin shells.
Austr. Mus. Mag., 5 (10), April-June 1935, pp. 332-339, frontispiece & 4 figs.

23. Shellfish poisoning.
Austr. Mus. Mag., 5 (11), July 16, 1935, pp. 393-394 & fig.

24. Australian Shells: the liotias, wheel shells, nerites, cap, sugar and true limpets.
Austr. Mus. Mag., 5 (11), July 16, 1935, pp. 395-400, 8 figs.

25. Economics of the marine shells of Australia and New Zealand.
[Title only] *Rept. 22nd.* (*Melbourne, 1935*) *meeting A.N.Z.A.A.S.* (Melbourne: Govt. Printer, 1935), p. 165.

26. Poisonous shellfish.
Med. J. Austr., 2 (16), Oct. 19, 1935, pp. 554-555, figs. 1-6 [Cones].

27. Australian shells: winks, rissoids, rissoinids and stump shells.
Austr. Mus. Mag., 5 (12), Oct.-Dec. 1935, pp. 420-424, 6 figs.

28. Australian shells: the slipper, cup-and-saucer, cap and horse-hoof limpets, horn shells and triphoras.
Austr. Mus. Mag., 6 (1), Jan.-Mch. 1936, pp. 26-31, 5 figs.

29. Australian shells: screw, blind, hairy-keeled and worm shells, violet snails, carrier shells and others.
Austr. Mus. Mag., 6 (2), April-June 1936, pp. 64-69, 6 figs.

30. *Mysticoncha*, a new generic name for *Caledoniella* Basedow, *non* Souverbie.
Rec. Austr. Mus., 19 (6), Oct. 7, 1936, pp. 391-396, pls. 25-26 & fig. in text; and *Austr. Mus. Ann. Rept.*, 1937, p. 11.

31. Australian shells: strombs, scorpion or spider shells, sea butterflies and ladder shells.
Austr. Mus. Mag., 6 (4), Oct.-Dec. 1936, pp. 121-126, 6 figs.

32. The opisthobranchiate fauna of New Zealand, a comparison with the Australian fauna.
Rept. 23rd (*Auckland, 1937*) *meeting A.N.Z.A.A.S.* (Wellington: Govt. Printer, 1937), p. 134.

33. Sea-slugs. Subclass Opisthobranchia.
Austr. Zool., 8 (4), March 12, 1937, pp. 261-263 & fig. [Middleton Reef species.]

34. Australian shells: the tritons, warped shells, frog shells and sand snails.
Austr. Mus. Mag., 6 (7), July-Sept. 1937, pp. 230-236, 9 figs.

35. Breeding habits of a female octopus (By A. S. Le Souef & J. K. Allan).
Austr. Zool. 9 (1), Nov. 12, 1937, pp. 64-67, pls. 6-7.

36. Exhibit of shells commensal-parasitic on starfish, sea-urchins, mantis shrimps, and bêche de mer.
Abstr. Proc. Linn. Soc. N.S.Wales 500, Aug. 27, 1937, p. [2]; *Proc.,* 62, 1937, pp. xlii-xliii.

37. Australian shells: helmet, tun, fig and eggshells, and the cowries.
Austr. Mus. Mag., 6 (8), Oct.-Dec. 1937, pp. 280-288, 7 figs.

38. Australian shells: volutes and melon shells, olives, rice, harp, margin and cross-barred shells.
Austr. Mus. Mag., 6 (9), Jan-Mch. 1938, pp. 309-315, frontispiece & 7 figs.

39. Australian shells: augur and cone shells.
Austr. Mus. Mag., 6 (10), April-June 1938, pp. 328-336, 8 figs.

40. Australian shells: spindle and band shells, whelks and the false trumpet shell.
Austr. Mus. Mag., 6 (12), Oct.-Dec. 1938, pp. 417-422, 5 figs.

41. Australian shells: mitres.
Austr. Mus. Mag., 7 (1), June-Aug. 1939, pp. 13-16, 3 figs.

42. Australian shells: dog whelks, dove shells, ivory shells and small whelks.
Austr. Mus. Mag., 7 (2), Sept.-Nov. 1939, pp. 67-72, 6 figs.

43. A review of the relationships of the mollusca of Lord Howe Island (By J. Allan & Tom Iredale).
Rept. 24th (Canberra, 1939) meeting A.N.Z.A.A.S., (Sydney: Austr. Med. Publ. Co., Dec. 1939), p. 113. [See also no. 52, below.]

44. Australian shells: rock shells, smoke shells and trophons.
Austr. Mus. Mag., 7 (3), Dec. 1, 1939, pp. 81-86, 5 figs.

45. [Book review:] "A collection of Japanese shells . . .", by Shintaro Hirase.
Austr. Mus. Mag., 7 (3), Dec. 1, 1939, p. 108.

46. A rare stalk-eyed squid (*Bathothauma lyromma* Chun) new to Australian waters.
Rec. Austr. Mus., 20 (5), March 15, 1940, pp. 320-324, figs. 1-7.

47. Australian shells: the purples and their near relatives.
Austr. Mus. Mag., 7 (4), March 1, 1940, pp. 140-144, 5 figs.

48. Cleaning and polishing shells.
Austr. Mus. Leaflet, 12, April 1940, 2 pages.

49. Australian shells: bubble and allied shells.
Austr. Mus. Mag., 7 (5), June 1, 1940, pp. 174-178, 7 figs.

50. The production of natural history films.
Red Tape, June 25, 1940, pp. 437-439 & fig.

51. Australian shells: ear and siphon shells, brackish water slugs and snails.
Austr. Mus. Mag., 7 (6), Sept. 2, 1940, pp. 197-201, 4 figs.

52. A review of the relationships of the mollusca of Lord Howe Island (By J. K. Allan & Tom Iredale).
Austr. Zool., 9 (4), Dec. 9, 1940, pp. 444-451, map. [See also no. 43, above.]

53. Australian sea-hares and tailed sea-slugs.
Vict. Nat., 57 (10), Feb. 1941, pp. 178-182, figs. 1-11.

54. New parts for old in the shellfish world.
Austr. Mus. Mag., 7 (8), March 10, 1941, pp. 280-285, 6 figs.

55. Capsules or girdles?
Austr. Mus. Mag., 7 (9), June 10, 1941, pp. 291-296, frontispiece & 4 figs.

56. Any port in a storm.
Austr. Mus. Mag., 7 (10), Sept. 1, 1941, pp. 345-346, fig.

57. Uninvited guests.
Austr. Mus. Mag., 7 (11), Dec. 15, 1941, pp. 373-376, 4 figs. [Shells parasitic on echinoderms, etc.]

58. The watering-pot shell.
Austr. Mus. Mag., 7 (12), March 15, 1942, p. 425, fig.

59. Showy shells from the South Pacific.
Austr. Mus. Mag., 8 (7), March-May 1944, pp. 219-223, frontispiece & 6 figs.

60. Our front cover. The garden snail.
Austr. Mus. Mag., 8 (8), June-Aug. 1944, p. 251, front cover.

61. Our front cover. Branched murex shell.
Austr. Mus. Mag., 8 (9), Sept.-Nov. 1944, p. 287, front cover.

62. Lights under the sea. Jewelled squids.
Austr. Mus. Mag., 8 (10), Feb. 1945, pp. 341-345, 6 figs.

63. Planktonic cephalopod larvae from the eastern Australian coast.
Rec. Austr. Mus., 21 (6), June 25, 1945, pp. 317-350, pls. 24-27 and map.

64. Observations on the egg-case and young of the baler shell, *Melo umbilicata* Brod. (By J. Allan & T. C. Middleton.)
Vict. Nat., 62, Feb. 1946, pp. 172-177, pls. 8-11.

65. Bivalve shells of a sandy ocean beach.
Austr. Mus. Mag., 9 (1), March 1, 1946, pp. 17-23, 7 figs.

66. Our front cover. The long spined thorny oyster.
Austr. Mus. Mag., 9 (2), June 1, 1946, p. 37, front cover.

67. An introduced tree snail becomes a pest.
Art Gall. Mus. Assoc. Austr. N.Zeal. News Bull. 1, Feb. 1947, pp. 7-8 [*Achatina panthera* var. *leucostyla*].

68. The present position of the Australian molluscan fauna [Title only].
Rept. 25th. (Adelaide, 1946) meeting A.N.Z.A.A.S. (Adelaide: Govt. Printer, 1947), p. 102.

69. The Trochus.
Fisheries Newsletter, 6 (2), April 1947, pp. 20-21 & 23, 3 figs. [Miss Allan also identified Swain Reefs Trochus shells in *Fisheries Newsletter* 11 (1), Jan. 1952, p. 23, 2 figs.]

70. Bivalve shells of a tidal flat, I.
Austr. Mus. Mag., 9 (4). April 30, 1947, pp. 122-126, 5 figs.

71. Book review: "South Australian Shells", by Bernard C. Cotton.
Austr. Mus. Mag., 9 (4), April 30, 1947, p. 126.

72. Nudibranchia from the Clarence River heads, north coast, New South Wales.
Rec. Austr. Mus., 21 (8), May 9, 1947, pp. 433-463, pls. 41-43 and map.

73. *Onchidium* associated with dead coral (By J. Allan & Philip J. Bell). *Austr. Nat.*, 11 (6), July 1947, pp. 149-157, figs. 1-4 on unnumbered plate.

74. Bivalve shells of a tidal flat, II. *Austr. Mus. Mag.*, 9 (5), Aug. 30, 1947, pp. 155-159, 3 figs.

75. Left or right turn. *Austr. Mus. Mag.*, 9 (6), Dec. 31, 1947, pp. 207-210, 5 figs.

76. A rare giant squid. *Austr. Mus. Mag.*, 9 (9), Dec. 31, 1948, pp. 306-308, 2 figs., and in *Fisheries Newsletter*, 7 (6), Dec. 1948, p. 25, fig.

77. Brachiopods — shelled sea creatures. *Austr. Mus. Mag.*, 9 (10), March 30, 1949, pp. 333-336, 4 figs.

78. Giant African snail — a crop destroying traveller. *Austr. Mus. Mag.* 9 (11), June 30, 1949, pp. 374-377, fig.

79. Our frontispiece. *Austr. Mus. Mag.*, 9 (12), Sept. 30, 1949, p. 419 & frontispiece [Thorny oyster and angel's wings shells].

80. Our front cover. *Austr. Mus. Mag.*, 10 (1), Dec. 1949, p. 1, front cover [Perspective sundial shell].

81. Land shells of Australia. Part I. *Austr. Mus. Mag.*, 10 (2), March 1950, pp. 50-54, 5 figs.

82. Mollusca. *Australian Fisheries (Handbook of 2nd meeting of Indo-Pacific Council)* (Sydney: Halstead Press), April 1950, pp. 37-41.

83. *Australian shells, with related animals living in the sea, in freshwater and on the land.* (Melbourne: Georgian House), 1950, pp. i-xix + 1 - 470, illustr. (some plates in colour), maps. An Australiana Society Publication. *The same*: Revised edition, Melbourne: Georgian House, 1959, pp. i - xxi + 1 - 487. *The same*: Reprinted, 1962.

84. Land shells of Australia, Part II. *Austr. Mus. Mag.*, 10 (3), Sept. 1950, pp. 80-83, 4 figs.

85. Australian shells. *Austr. Junior Encyclopaedia*, 2, 1951, pp. 875-881, colour-plate facing p. 892 and text-figs. (Melbourne: Georgian House). A Sydney edition in 1956: vol. 3, pp. 875-881, illustr. (Sydney: Austr. Educational Foundation).

86. Harold Sutcliffe Mort, B.Sc., B.E. *Proc. Roy. Zool. Soc. N.S.Wales*, 1949-50 (April 2, 1951), p. 10.

87. [Book review:] "Opisthobranchs of Sagami Bay." *Proc. Roy. Zool. Soc. N.S.Wales*, 1949-50 (April 2, 1951), pp. 72-73.

88. Aftermath of rain. *Austr. Mus. Mag.*, 10 (6), June 1951, pp. 200-202, fig.

89. [Book review:] "A Beginner's Guide to South African Shells," by K. H. Barnard. *Austr. Mus. Mag.*, 10 (10), June 1952, p. 340.

90. Diving for pearls. *The Times* (London) 52685, July 28, 1953, p. 7, map.

91. Introduced grey slug.
Austr. Mus. Mag., 11 (6), June 1954, pp. 175-176, fig.

92. A man and a museum — Sir Hans Sloane, Bart.
Austr. Mus. Mag., 11 (7), Sept. 1954, pp. 215-218, 3 figs.

93. Book review: Copenhagen Decisions on Zoological Nomenclature.
Proc. Roy. Zool. Soc. N.S.Wales, 1952-53 (1954), pp. 42-43 = *Marine Zoologist* 1 (2), 1954, pp. 42-43.

94. Book review: "American seashells", by R. Tucker Abbott.
Austr. Mus. Mag., 11 (8), Dec. 15, 1954, p. 271.

95. A masterpiece of shell architecture.
Austr. Mus. Mag., 11 (9), March 15, 1955, p. 274, fig. [*Thatcheria mirabilis.*]

96. The kraken — legendary terror of the seas.
Austr. Mus. Mag., 11 (9), March 15, 1955, pp. 275-278, 2 figs.

97. Shell shapes.
Austr. Mus. Mag., 11 (10), June 1955, pp. 320-321, 10 figs.

98. More about the kraken.
Austr. Mus. Mag., 11 (11), Sept. 1955, p. 372.

99. Shells.
Austr. Mus. Mag., 11 (11), Sept. 1955, p. 373.

100. Shells.
Austr. Mus. Mag., 12 (1), March 1956, p. 26.

101. What is the difference between the *Cypraea Umbilia hesitata* and *Umbilia hesitata beddomei*?
Malac. Club Vict. Newsletter, 4 (12), Jan. 30, 1956, pp. [4-5.]

102. The reappearance of a rare Australian volute shell, *Amoria grossi* Iredale (Mollusca: Gastropoda), a new record for New South Wales.
Proc. Roy. Zool. Soc. N.S.Wales, 1954-55 (April 10, 1956), pp. 48-49, fig. 1.

103. *Cowry shells of world seas.* (Melbourne: Georgian House), May 15, 1956, pp. i - x + 1 - 170, pls. 1-15, some in colour. An Australiana Society Publication.

104. Congratulations on . . . B. C. Cotton's 'Thaididae'.
Malac. Soc. Austr. Newsletter, 4 (15), Oct. 29, 1956, p. 5.

105. Shells of a tidal flat.
Austr. Mus. Leaflet, 33, April 1957, 4 pp., figs. 1-8. Reprinted, Dec. 1960, 4 pp., figs. 1-8, and Oct. 1964 4 pp., 10 figs. by B. Bertram.

106. Some Opisthobranchia (Class Gastropoda) new to Australia or otherwise of interest.
J. Malac. Soc. Austr., 1, Sept. 13, 1957, pp. 3-7, figs. 1-3.

107. Obituary [Mrs. Leone (Lee) Woolacott].
J. Malac. Soc. Austr., 1, Sept. 13, 1957, p. 48.

108. Lee Woolacott.
Proc. Roy. Zool. Soc. N.S.Wales, 1956-57 (June 27, 1958), p. 81 [Obituary notice].

109. Some species of Lamellariidae (Class Gastropoda) from the eastern Australian coast.
J. Malac. Soc. Austr., 2, Nov. 1958, pp. 48-57, pls. 10-12.

110. *The sea-horse and its relatives* (By G. P. Whitley & J. K. Allan). (Melbourne: Georgian House), Dec. 22, 1958, pp. i - x + 1-84, coloured frontispiece & text-figs. 1-24.

111. Australwinks.
Austr. Encyclopaedia, ed. 2, 1, 1958, p. 341.

112. Mollusca.
Austr. Encyclopaedia, ed. 2, 6, 1958, pp. 117-135, coloured plate 124A and text-figs.

113. Trochus shell.
Austr. Encyclopaedia, ed. 2, 9, 1958, p. 39.

NEW FAMILY, SUBFAMILY, GENERIC AND SPECIFIC NAMES

The first number after each name refers to Miss Allan's paper in the above bibliography, the second number (after the colon) to the page on which the new name first appeared.

albobrunnea, Dendrodoris 11: 448
aurantiomaculata, Dictyodoris 5:91
brassica, Asteronotus 5:93
cameroni, Archidoris 72:450
capricornensis, Platydoris 5:91
conspicua, Polycera 5:101
Ctenopterygidae, new family 63:328
davisi, Dendrodoris 11:447
dorsalis, Pleurobranchaea 11:445
extraordinaria, Tethys 8:319
gunnamatta, Dendrodoris 5:97
iredalei, Platydoris 5:89
Leptoichthyinae, [new subfamily of fishes] 110:58 & 61
livingstonei, Nembrotha 11:450
megastigma, Notodoris 5:103
melaena, Dendrodoris 5:98
mirifica, Propemelibe 8:314
morulifer, Dendrodoris 5:99
Mysticoncha 30:391
palma, Discodoris 11:448
Propemelibe 8:314
rex, Ramosaclesia 8:317
rainfordi, Dendrodoris 5:100
sagittus, Strombus 31:121 & 123
sanguinea, Aglaia 11:445
serventyi, Heteroteuthis 63:319 & 340
sheardi, Eledonella 63:320 & 345
taronga, Aglaia 11:444
wardianus, Asteronotus 5:95
whitleyi, Discodoris 5:88

ACKNOWLEDGMENTS

For help in writing the above notice and bibliography, I am grateful to the late Mr. H. W. Kirkpatrick, Mr. Tom Iredale, the staff of the Department of Molluscs and the Library of the Australian Museum, and those of the Public Library of New South Wales and the Mitchell Library, Sydney.

CONCHOLOGISTS OF THE PAST

1. Father Xavier Montrouzier (1820-1897)

By

GILBERT P. WHITLEY*

Plate 9

Under the above title I hope to contribute a series of biographical notes with portraits of some of the conchologists of other days. These will follow no set plan or order, but it is intended to recall facts, perhaps little known, about those interesting personalities (and their writings) to whom science is still indebted for their pioneering work. For the first in the series I have chosen Père Montrouzier. The photograph of Montrouzier in the field is one of a collection of portraits of zoologists assembled by the late Charles Hedley and now maintained in the Department of Molluscs, Australian Museum, Sydney. I am grateful to Dr. D. F. McMichael, Curator of Molluscs, for placing it at my disposal. Grateful acknowledgment is also due to the Mitchell Library, Sydney, which holds various rare publications by or about Montrouzier which I have consulted there. For biographical information I have drawn mainly from Rev. Patrick O'Reilly's work[1] which describes Montrouzier's life and labours and appends a bibliography of his writings, correspondence and manuscripts.

Xavier Montrouzier was born in the south of France at Montpellier on 3rd December 1820. After college, he was introduced into scientific circles in Paris, having shown interest in botany and in collecting beetles. Then, as a Marist priest, he left with a small party of missionaries for the Solomon Islands, sailing from London on 2nd February 1845 on the *Bussorah Merchant;* he had permission to use his leisure in the study of natural history. At Sydney, he had to wait nearly five months before a vessel could take him to the Solomons. He haunted the Botanic Gardens and studied plants on his long walks between Sydney and Botany Bay. In December 1845, the missionaries landed on the Solomons, only to see their bishop murdered. Two months later, Montrouzier was himself wounded by a spear-thrust from a native, of such force that it was impossible to extract the shaft from the wound which remained open for months, but gradually he managed to get about and went to New Caledonia to recuperate. But in September 1847 he returned to his duties in the Solomons. A new mission had been established at Woodlark Island, to which the now fever-wracked Montrouzier was appointed. He had written a dictionary, had mingled with interior native tribes and whenever possible had botanized, set his insects, drawn and described his natural history discoveries. One of these was the rare and fantastic orthopterous insect, *Eurycantha horrida,* which burrowed in trees. Woodlark was a small island, mammals were absent, birds were few, so Montrouzier studied

---

* Honorary Associate, The Australian Museum, Sydney.

[1]) O'Reilly, (Rev.) Patrick, 1931, Un missionnaire naturaliste: Xavier Montrouzier, 1820-1897. *Revue d'Histoire des Missions* (Besançon: Imprimerie catholique de l'est), Mars 1931: 1-24, consulted in the Mitchell Library, Sydney.

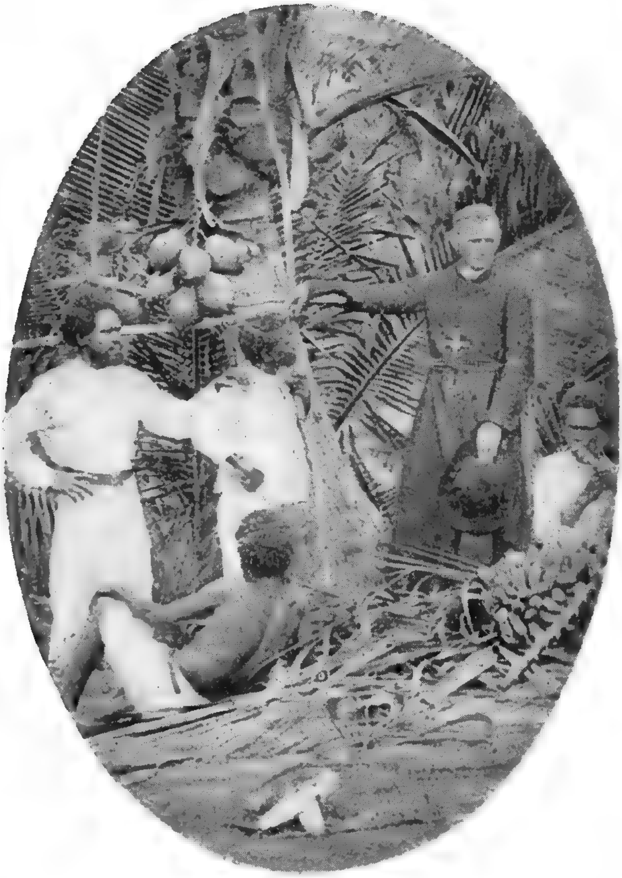


PLATE 9

Father Xavier Montrouzier (1820-1897)

fishes. He sent his drawings, writings and specimens to the Société Impériale d'Agriculture, d'Histoire Naturelle et d'Arts Utiles at Lyon, France. His papers, unfortunately, reached Lyon without his packages which were lost in transit. Moreover, Victor Thiollière, the member of the Société charged with the editing and production of the material, did not consider Montrouzier's sketches suitable for reproduction. So the Fauna of Woodlark Island finally appeared in a disappointing, reduced form[2].

[2]) Montrouzier, X. (Revised by V. Thiollière), 1856, Essai sur la faune de l'ile de Woodlark ou Moiou. *Ann. Soc. Imp. Agric. Hist. Nat. Lyon,* 8, 1856: 278-504; reprinted by F. Dumoulin, Lyon, in 1857, repaged 1-226 + index: 1-8. Molluscs are on pp. 412-416 of original Annals, 134-138 of reprint.

After leaving the Woodlark Island mission, Montrouzier stayed in Sydney from August 1851 to January 1853 and was encouraged by Sir William Macleay, W. S. Wall (the Curator of the Australian Museum), and other naturalists to set his researches in order for publication. Montrouzier left Sydney for New Caledonia in January 1853 where as premier chaplain he ministered to officials, soldiers, convicts and natives, continuing meanwhile with his conchological and other collecting, geology, botany and horticulture. In 1858 he spent eight months on the Loyalty Islands and in subsequent years travelled widely in New Caledonia. Brazier met him there in 1873 and noted (in MSS., Mitchell Library) that Montrouzier was in Sydney at the Exhibition in 1879-80. In 1893 he retired to Saint-Louis where he died on 16th May, 1897 after over half a century as a missionary in Oceania. He had been a voluminous letter-writer but his biographer, Rev. P. O'Reilly, wrote, "God alone knows in what lumber-rooms his letters are mouldering". Sometimes Montrouzier's papers were printed without his having seen proofs, so that errors crept in for which he was not responsible. Dr. G. Beauvisage assembled some of Montrouzier's botanical collections and tried to catalogue the New Caledonian plants. One collection, sent to Montpellier, contained plants from Australia, Tahiti, Réunion, Madagascar and the Indies. Montrouzier's shells were sent to various museums (Bordeaux, for example) and Rome. Gassies described land and river shells from New Caledonia, documented and collected by Montrouzier, who often had to run the risk of attack by savages, so he asked his correspondent to wait until calm is restored before he sends shells: "Martyr pour la réligion, tres bien . . . Mais pour la science . . .", the sentence was left unfinished! The brave priest, at Tuo in April 1862, had seen his mission pillaged and his collections destroyed by hostile natives. We look back now with respect on this humble apostle, "ce petit Père au long nez", as O'Reilly refers to him, this physically frail man, as versed in the languages of the South Seas as in Latin, Greek and his native French. His new shells were described and figured in the Journal de Conchyliologie from 1857 to 1879, partly by him and partly by Saint-Martin-Souverbie. Montrouzier also wrote on insects, crustacea, topography, native races and the history of the Catholic mission in which he played his part so faithfully.

When dedicating his new genus *Eumontrouziera* to Montrouzier, Hedley[3] gave "a few notes on his career" in such glowing prose that my observations above pale in comparison.

---

[3]) Hedley, C., 1915, Studies in Australian mollusca. Part xii. *Proc. Linn. Soc. N.S.W.*, 39 (4), 1914 (1915): 695-755, pls. 77-85 (*Eumontrouziera,* pp. 703-704).

TENTACLE RETRACTION IN TRACHEOPULMONATA*

By

J. B. BURCH**

Text-figs. 1-7

The position of the eyes and the method of withdrawal of the tentacles of pulmonate gastropods have been observed by various workers for many years. The fundamental importance attributed to the position of the eyes in regard to the tentacles may be seen in the names of the two most prominent pulmonate orders, STYLOMMATOPHORA Schmidt (1855) and BASOMMATOPHORA Keferstein (1864). Snails of the order Basommatophora, mostly freshwater inhabitants (but some taxa live in the sea, and a few are essentially land snails), have their eyes at the bases of the single pair of tentacles. Snails of the order Stylommatophora, all basically land inhabitants, have their eyes on the tips of the upper and larger pair of tentacles†. An additional noteworthy difference between these two groups in regard to their tentacles is in the musculature responsible for tentacle retraction. Tentacles of the Basommatophora, on direct physical stimulation, withdraw by simply shortening and thickening (Fig. 1). The tentacles of the Stylommatophora, on the other hand, are withdrawn by a progressive inversion beginning at the distal end and proceeding proximally (Fig. 2).

Sarasin & Sarasin (1899), after studying the anatomy and embryology of the Veronicellidae, concluded that these terrestrial slugs had descended from shelled gastropods which were neither Basommatophora nor Stylommatophora, but shared features of both of these groups as they are known today. Members of this family have their eyes placed at the tips of the upper pair of tentacles, like the Stylommatophora, but they retract them similarly to the Basommatophora, i.e., by contraction (Fig. 3). Pilsbry (1948) proposed the order SYSTELLOMMATOPHORA for this group of slugs (together with the onchidellids), and placed as first importance the method of withdrawal of the tentacles ("Pulmonata

---

* Research supported (in part) by grant GB-5601 from the National Science Foundation, Washington, D.C. The material on which this report is based was collected under the auspices of National Science Foundation Grant GB-3974.

** Curator of Mollusks, Museum of Zoology, and Associate Professor, Department of Zoology, The University of Michigan, Ann Arbor. Supported (in part) by a Research Career Program Award (5-K3-AI-19, 451) from the National Institute of Allergy and Infectious Diseases, U.S. Public Health Service.

† The only apparent exceptions to this condition in the Stylommatophora are in the Athoracophoridae and the Pupillidae (see Pelseneer, 1897 and Pilsbry, 1948). The Athoracophoridae, and among the Pupillidae. *Columella* and *Pupisoma,* have only one pair of tentacles (the upper pair), and the pupillid *Vertigo* is apparently totally without tentacles.

in which the eyes are on contractile (not inversible) stalks"*). He included as synonyms the following: *Ditremata* Fischer (1883), *Teletrema* Pilsbry (1898), *Digonopora* Suter (1913), and *Onchidiacea* and *Soleolifera* Thiele (1931).

The importance in current taxonomic schemes given to the position of the eyes in regard to the tentacles, and the method of withdrawal of the tentacles, induced me to present my observations on the tentacular characteristics of several species of the odd South Pacific land slug family Athoracophoridae, since their method of tentacle withdrawal has not been stressed in previous literature. This method differs basically from that found in other pulmonate snails, and especially from that found in the Stylommatophora, where they are usually placed.

Simroth (1890, *fide* Solem, 1959) proposed the taxon TRACHEOPULMONATA for the athoracophorid slugs, which possess the anomalous "lung" that has been compared by Simroth and others to the tracheal system of insects. The presence of only one pair of tentacles in this aberrant group was noticed as early as 1832 by Quoy and Gaimard, who named a New Zealand slug *Limax bitentaculatus* (the type species of Gould's (1852) genus *Athoracophorus*, on which Fischer (1883) based his family Athoracophoridae). Others have made note of tentacular retraction in tracheopulmonate slugs. For example, Gray (1860) included the "Aneiteadae" and "Janelladae" [Athoracophoridae] in his group A of the "Pulmonata geophila", distinguished by "head, eye-peduncle, and tentacles retractile under the skin," in contrast to his group B ("Vermicellidae" and "Onchidiadae") in which the "head, eye-peduncle, and tentacles [are] simple, contractile." Hedley (*fide* Pfeiffer, 1900) described the tentacles of his *Aneitea* from Brisbane as contractile and retractile. Glamann (1903) characterized (in part) the Janellidae as having two tentacles, which can be invaginated by several retractors and carry eyes on a terminal knob. Suter (1913) noted that in *Athoracophorus papillatus* "the anterior half [of the tentacles are] narrower than the posterior, and telescoped into the latter when retracted". Thiele (1931) said of the Tracheopulmonata, "Kopf mit 2 augentragenden, einstülpbaren Fuhlern . . ." None of these descriptions precisely characterize tentacle retraction in *Aneitea* as described in the present paper, although Hedley's and Suter's are the most accurate, as brief as they are.

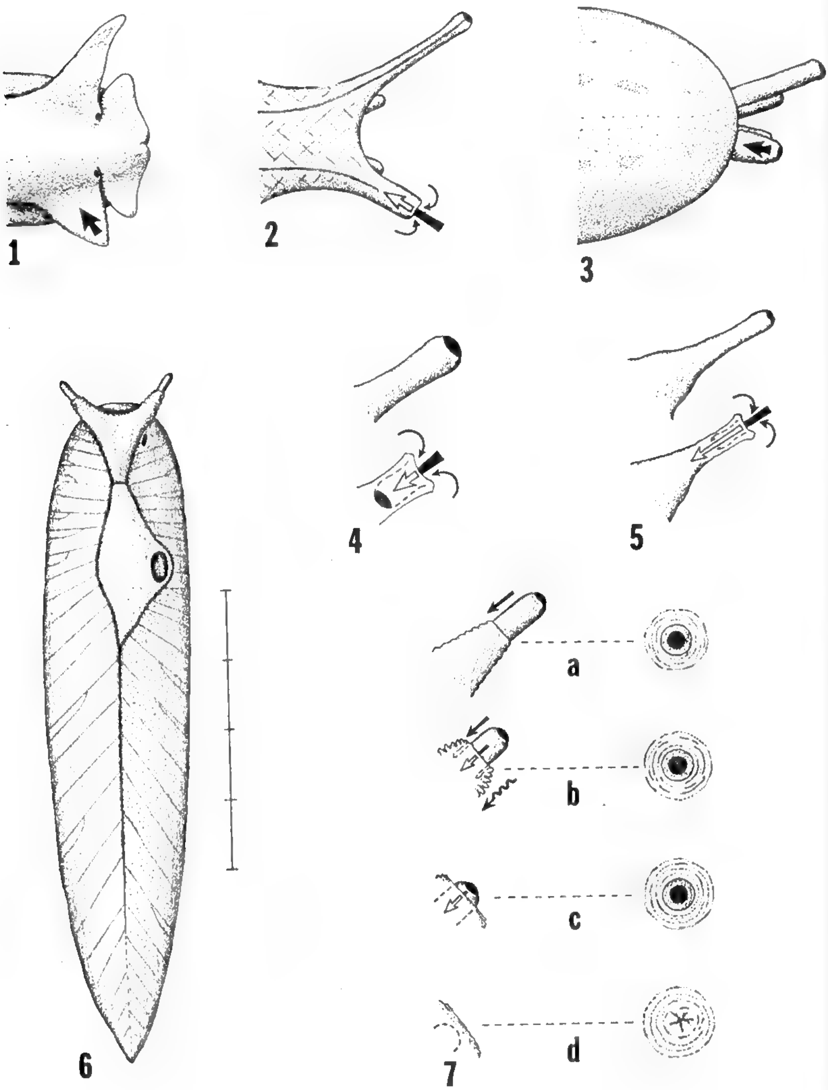
My observations were made on many living specimens of several species of *Aneitea* from Éfaté, Malekula and Tanna Islands while I was in the New Hebrides in January and February, 1967. Specific determinations of the material are not given here because of the present uncertainty regarding identification. Assignment of specific names must await a detailed anatomical study of my specimens, and comparisons with Grimpe & Hoffmann's (1925) material. Solem (1959) pointed out the difficulty of species discrimination in New Hebridean athoracophorid slugs. However, exact species determinations are not important for the purposes of the current paper, since the observed behaviour of tentacle retraction was the same for all specimens examined.

In New Hebridean *Aneitea* species the anterior and posterior (or distal and proximal) portions of the tentacles are clearly demarcated. The anterior portion is rod-like with the eye at its tip (Fig. 7a). The posterior part is ordinarily somewhat concentrically furrowed and

---

* However, at least the genera *Onchidella* and *Onchidium* of the Onchidiacea have invaginable rather than contractile tentacles (Figs. 4, 5) (see also Plate, 1893).

tapers outward to its base. When the tentacle is retracted, the anterior part does not contract, but is pulled into the posterior part, which contracts by an accordian-like pleating (Fig. 7b). As retraction continues, the anterior part is pulled further into the posterior part, which itself (after being completely folded) begins to be pulled into the body wall. At a point of near extreme contraction, before the tip of the anterior peduncle disappears within the snail's head, the eye at the tip is clearly observable (Fig. 7c), and not inverted, as is the case in



the other Stylommatophora. On extreme retraction, the eye disappears within the body wall (Fig. 7d), still not inverted. As the eye stalk begins to reappear as the tentacle is again pushed out, it can clearly be seen that the eye has not inverted within the anterior peduncle.

As shown in Fig. 7, the tentacles of *Aneitea* are not "inversible" or "introvertable" (in the sense those terms have been used for the Stylommatophora), nor are they "contractile" (in the sense of the Basommatophora and Soleolifera). However, the proximal portions of the tentacles can be contracted and, along with the eye stalk, invaginated into the snail's anterior body. But, the distal eye stalk itself is not inverted, and the eye remains at its tip until it is finally withdrawn into the invaginating lower portion of the tentacle. Thus, in this respect the tentacles of this genus, and presumably those of other Tracheopulmonata, exhibit a significant and perhaps basic difference from the completely inversible tentacles of all Stylommatophora known to me, including the Succineidae (which are sometimes considered to be related to the Tracheopulmonata). The tentacles of *Aneitea* also differ from the other pulmonate groups: the Basommatophora, Soleolifera and Onchidiacea (Table 1).

Plate (1898), Simroth (1920) and others, although not precisely describing tentacular retraction, have pointed out the basic differences in the tentacular retractor muscles of tracheopulmonate slugs from those known in the Stylommatophora.

It is concluded from these brief observations that, if tentacular structure and mode of tentacle retraction are given importance in dividing the orders of the Pulmonata, then these characters, together with the other known gross differences between the Athoracophoridae and the Succineidae (including a holopod foot in the former and an aulacopod foot in the latter), indicate that the tracheopulmonate slugs are not closely related to the stylommatophoran succineids, and should not be included as a subfamily of the Succineidae as advocated by Cockerell (1891), or perhaps even together with them in the Heterurethra as has been suggested by Baker (1955). Pilsbry (1948) reached a similar conclusion about their taxonomic placement, i.e., that the Tracheopulmonata should be considered as a separate order removed from the Heterurethra.

TEXT-FIGS. 1-7. Types of tentacle retraction in Pulmonata

1. Basommatophora [*Radix auricularia* (Linnaeus). Detroit, Michigan, U.S.A.]
2. Stylommatophora [*Triodopsis* sp., Ann Arbor, Michigan, U.S.A.]
3. Soleolifera [*Veronicella floridana* (Leidy), Florida, U.S.A.]
4. Onchidiacea [*Onchidella evelinae* Marcus & Burch, Marshall Islands]
5. Onchidiacea [*Onchidium* sp., New Hebrides]

6-7. Tracheopulmonata [*Aneitea* sp., New Hebrides]

6. Dorsal view of slug.
7. Progressive degrees of tentacle retraction are shown in a-d. Lateral views are shown in the left column, and corresponding dorsal views of the retracting tentacle are shown in the right column.

Measurement line (in cm) is for Fig. 6 only. Figs. 2-3 are from Burch (1962).

TABLE 1

Taxa	Pairs of tentacles	Location of eyes in relation to tentacles	Type of tentacle retraction	Complete withdrawal of eye into body
Basommatophora	1	base	contractile	No
Soleolifera	2	tip	contractile	No
Onchidiacea	1	tip	inversible	Yes
Stylommatophora	2	tip	inversible	Yes
Tracheopulmonata	1	tip	contractile and invaginable	Yes

TABLE 1. Tentacle characteristics of pulmonate snails.

LITERATURE CITED

BAKER, H. B., 1955. Heterurethrous and aulacopod. *Nautilus,* 68(4): 109-112.

BURCH, J. B., 1962. *The eastern land snails.* 214 pp. Wm. C. Brown, Dubuque, Iowa.

COCKERELL, T. D. A., 1891. On the geographical distribution of slugs. *Proc. zool. Soc. Lond.,* pp. 214-226.

FISCHER, P., 1880-87. *Manuel de Conchyliologie et de Paléontologie Conchyliologique.* 1369 pp., 23 pls. F. Savy, Paris.

GLAMANN, G., 1903. Anatomisch-systematische Beiträge zur Kenntniss der Tracheopulmonaten. *Zool. Jb., Anat. Ontog.,* 17: 679-762, pls. 29-34.

GOULD, A. A., 1852. *The Mollusca and shells of the United States Exploring Expedition under Cmdr. Wilkes.* Vol. 12, 510 + xv pp., 52 pls. Philadelphia.

GRAY, J. E., 1860. On the arrangement of the land pulmoniferous Mollusca into families. *Ann. Mag. Nat. Hist.* (3), 6: 267-269.

GRIMPE, G., & HOFFMANN, H., 1925. Die Nachtschnecken von Neu-Caledonien, den Loyalty-Inseln und den Neuen Hebriden. *In*: Sarasin, F. & Roux, J., *Nova Caledonia* (Zool.), 3(10): 339-476.

KEFERSTEIN, W., 1864. *In*: Bronn, H. G. & Keferstein, W., 1862-66, *Weichthiere* (*Malacozoa*), *in,* Bronn, H. G., Klassen und Ordnungen des Their-Reichs, 3(2): 523-1500, pl. 45-136. Leipzig, Heidelberg.

PELSENEER, P., 1897. Mollusques. *In*: Blanchard, R., *Traité de Zoologie* (16). 187 pp. Rueff et Cie, Paris.

PFEIFFER, W., 1900. Die Gattung *Triboniophorus*. *Zool. Jb., Anat. Ontog.*, 13: 293-358, pls. 17-20.

PILSBRY, H. A., 1898. A classified catalogue of American land shells, with localities. *Nautilus*, 11(11): 144.

————, 1948. *Land Mollusca of North America* (*North of Mexico*). II(2), pp. 521-1113 + i-xlvii. Monogr. (3), Acad. nat. Sci. Philadelphia.

PLATE, L. H., 1893. Studien űber opisthopneumone Lungenschnecken. II. Die Oncidiiden. Ein Beitrag zur Stammesgeschichte der Pulmonaten. *Zool. Jb., Anat. Ontog.*, 7: 93-234, pls. 7-12.

————, 1898. Beiträge zur Anatomie und Systematik der Janelliden. *Zool. Jb., Anat. Ontog.*, 11: 193-280, pls. 12-17.

QUOY, M. & GAIMARD, P., 1832. *Voyage de découvertes de l'Astrolabe exécuté par ordre du Roi, pendant les années 1826-1827-1828-1829, sous le commandement de M. J. Dumont d'Urville* Zoologie (2), 686 pp. J. Tastu, Paris.

SARASIN, P. & SARASIN, F., 1899. *Die Land-Mollusken von Celebes*. 248 pp., 31 pls. C. W. Kreidel, Wiesbaden.

SCHMIDT, A. W. F., 1855. Der Geschlechtsapparat der Stylommatophoren in taxonomischer Hinsicht. *Abh. Naturw. Ver. Sachsen u. Thüringen*, 1(1), 52 pp., 14 pls.

SIMROTH, H., 1920. Über einige Nachtschnecken vom Malayischen Archipel von Lombok on ostwärts bis zu den Gesellschafts-Inseln. *Abh. Senckenb. Naturf. Ges.*, 35(3): 261-302, pls. 18-20.

SOLEM, A., 1959. Systematics and zoogeography of the land and fresh-water Mollusca of the New Hebrides. *Fieldiana* (Zoology), 43: 1-359.

SUTER, H., 1913. *Manual of the New Zealand Mollusca*. 1120 pp. John Mackay, Wellington.

THIELE, J., 1931. *Handbuch der systematischen Weichtierkunde*. 778 pp. Gustav Fischer, Stuttgart.

A NOTE ON *EPITONIUM (GYROSCALA) PERPLEXUM* PEASE IN AUSTRALIA (GASTROPODA: EPITONIIDAE)

By JOY KERSLAKE.*

Plate 10

The report by Powell (1965, p. 161) of the first record for New Zealand of *Epitonium perplexum* (Pease, 1867) is interesting, though not surprising. The species is ubiquitous throughout the Indo-Pacific area and is also closely related to the Atlantic-Mediterranean *lamellosum* Lamarck. However, the name listed by Iredale and McMichael (1962) for similar shells from New South Wales, *Pomiscala perplicata* (Iredale, 1929), and mentioned by Powell, needs correction.

The name, *Scalaria perplexa* Pease, was first listed for Australia by Whitelegge (1889, p. 99), the Molluscan section being compiled by John Brazier. The next use of the name was by Hedley (1918, p. M65) where it appeared under the genus *Epitonium*. Iredale (1929, p. 344) re-named the N.S.W. shell *Scala perplicata* and subsequently (1936, p. 303) made it the type of a new genus, *Pomiscala*.

Taxonomy of species: For the following reasons *P. perplicata* is considered a synonym of *E. perplexum*:

(i) *Number of ribs on the body whorl*: Pease described a Hawaiian shell with 9-10 ribs; the holotype of *perplicata* Iredale has 13. A large series, ranging from north Queensland to eastern Victoria, shows wide variation from any one location. For example, in 30 shells from Long Reef, N.S.W., the range is from 8 to 15 ribs. Shells from Hawaii, examined recently, have a similar range.

(ii) *Shell colour*: The Hawaiian shell ". . . is dark brown at the sutures rarely the whole space between the varices coloured dark, purplish brown . . .". Iredale's *perplicata* was said to be uncoloured. Here again Iredale was mistaken because of insufficient comparative material. The uncoloured shell is not typical of the species in Australia. The majority have the sutural band of variable width and some have also a faint row of peripheral flecks and an additional basal band. The brown form also occurs here, rarely, as in Hawaii.

(iii) *Shell measurements*: Measurements of the holotype of *perplicata* in The Australian Museum, Sydney, show it to be 24 mm. in height by 12 mm. in width; not 36 mm. by 11 mm. as stated by Iredale. The drawing illustrating his type (Iredale, 1936) is curiously out of proportion in the opposite direction; the width is far too great. Pease gives 32 mm. x 13 mm. for the Hawaiian type. Here, again, the species in Australia, as elsewhere, shows considerable variation and shells of dimensions of the Hawaiian type occur.

Generic position: A generic change must also be made. As *perplexum* (=*perplicata*) is considered scarcely separable from the well-known *lamellosum* Lamarck, it follows that it should share the same genus

---

* 53 Alvie Road, Mt. Waverley, Victoria.

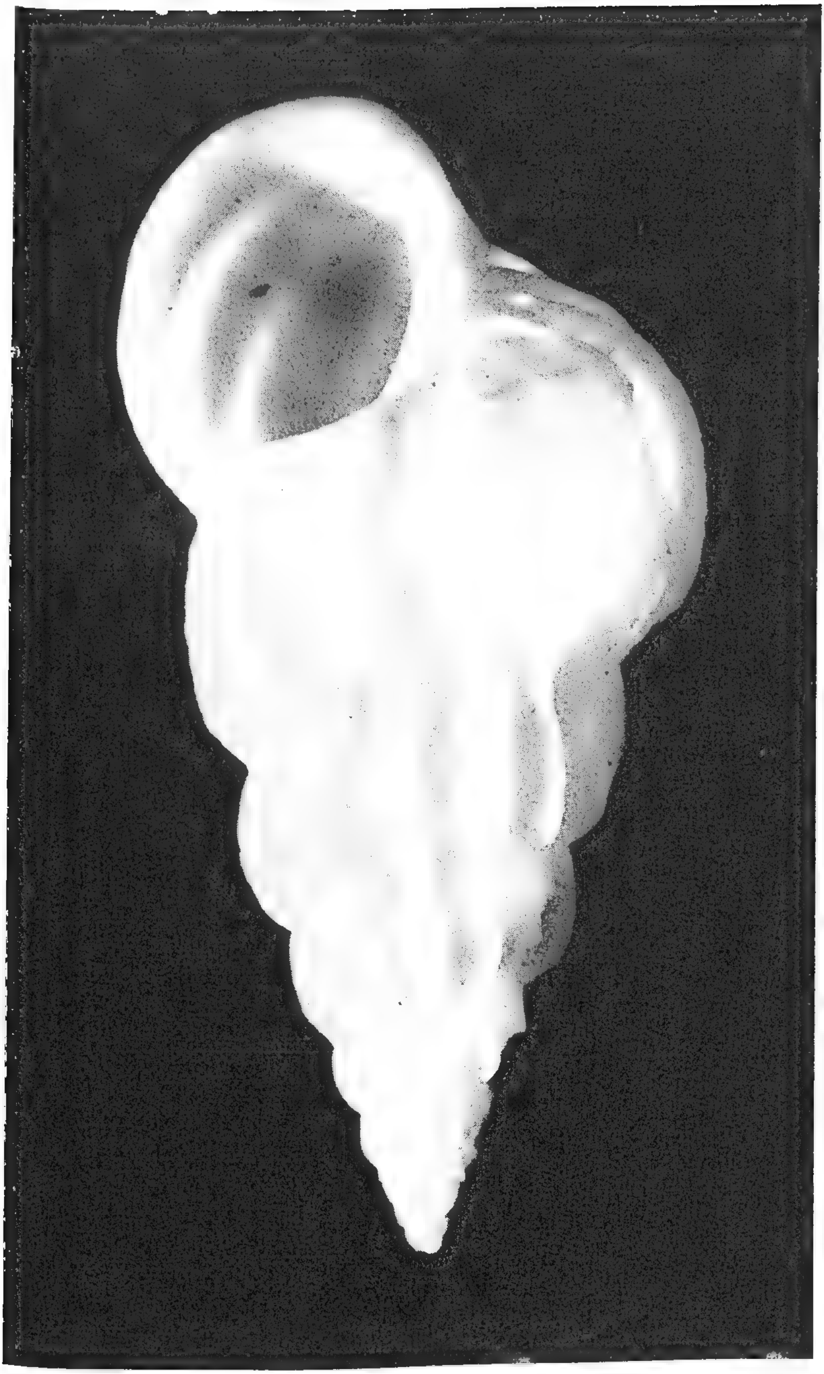


PLATE 10
Scala perplicata Iredale. Holotype, Australian Museum No. C 50457. Mallacoota, Vict., Coll. R. Bell. Photo: C. V. Turner.

or sub-genus. This is *Gyroscala* de Boury (1887, p. 15) of which *commutatum* Monterosato (=*lamellosum* Lam.) is the type species. Iredale's genus *Pomiscala* with type *perplicata* is therefore a synonym of *Gyroscala*. I propose to use *Gyroscala* as a sub-genus of *Epitonium* pending more detailed knowledge of this complex family.

Range: In eastern Australia the species has been collected from Mallacoota in north-eastern Victoria to Port Douglas, north Queensland. In Western Australia it is known from Rottnest Island near Perth and from Carnarvon. It is fairly safe to predict that with more intensive collecting in the north and north-west, these records will be much extended. *Scala* (*Pomiscala*) *reevesbyi* Cotton (1939), from Reevesby Island, South Australia, appears to be synonymous with *perplexum*, but I have not had the opportunity to examine the type.

Habitat: Shells on the east coast are found on rocky platforms exposed to the ocean and live specimens have been collected in the sand lying in shallow gutters between tide levels.

Eggs and Operculum: I have not seen the eggs of this species, but quote from a brief description of an animal observed at Coolum, south Queensland, sent to me by Mrs. Dulcie Freebairn of Gympie. It was ". . . on a green moss on the rocks and had just laid a string of eggs. The eggs were white and about the size of a pin head and were attached to a long string like a piece of cotton."

The operculum is light buff in colour, thin, corneous and paucispiral.

ACKNOWLEDGEMENTS

I am particularly grateful to Dr. D. F. McMichael for his assistance and to my many collector friends living along the eastern coast for the material they have provided.

REFERENCES

BOURY, E. de, 1887. *Etude sur les Sous-Genres de Scalidae du Bassins de Paris.*

COTTON, B. C., 1939. Article 8. The Sir Joseph Banks Islands. Report of the Expedition of the McCoy Society for Field Investigation and Research. Part 2, Section 4, Mollusca part 2. *Proc. Roy. Soc. Vic.*, 51: 172-173, pl. 7, fig., 1.

HEDLEY, C., 1918. A Check List of the Marine Fauna of N.S.W. Part 1. Mollusca. Supplement to *J. Roy. Soc. N.S.W.* 51: M65.

IREDALE, T., 1929. Strange Molluscs in Sydney Harbour. *Aust. Zool.*, 5: 344.

———, 1936. Australian Molluscan Notes No. 2. *Rec. Aust. Mus.*, 19: 303, pl. 22, fig., 24.

IREDALE, T., and D. F. McMICHAEL, 1962. A Reference List of the Marine Mollusca of N.S.W. *Mem. Aust. Mus.*, 11: 51.

PEASE, W. H., 1867. Descrirtions of Sixty-five New Species of Marine Gastropoda Inhabiting Polynesia. *Amer. J. Conch.*, 3: 288.

POWELL, A. W. B., 1965. New Zealand Molluscan Systematics with Descriptions of New Srecies. Part 5. *Rec. Auck. Mus.*, 6: 161-168., pls. 22, 23.

WHITELEGGE, T., 1889. List of the Marine and Fresh-water Invertebrate Fauna of Port Jackson and Neighbourhood. *Roy. Soc., N.S.W.*, p. 99.

A SURVEY OF THE SPECIES OF THE GENUS *PRONUCULA* IN NEW SOUTH WALES

By W. BERGMANS*

Plates 11, 12

INTRODUCTION

In 1961 Mr. J. Voorwinde collected some shell sand on the beach of Narrabeen and sent it to Mr. L. van der Slik in Rotterdam, who presented me with a part of it. I encountered hundreds of interesting small molluscs and decided to do some work on this collection. Systematically *Pronucula* was the first genus to be studied. One species appeared to be new for New South Wales: *Pronucula vincentiana*. Later I had the opportunity to examine some Nuculidae from various localities in New South Wales in the Collection Van der Slik. Here I found another species new for the fauna of New South Wales: *Pronucula cancellata*.

It seemed useful to give descriptions and figures of these species together with descriptions and illustrations of the other species of this genus that are known to occur in this region, because the original descriptions are often brief and the original illustrations rather poor in some cases. It is likely, after all, that more allied species will be found and for this reason the species have to be described very accurately.

I wish to thank Dr. C. O. van Regteren Altena, Curator of Molluscs of the Leiden Museum, Dr. D. F. McMichael, formerly Curator of Molluscs of the Australian Museum, and Mr J. Voorwinde for their worthful help during the preparation of this survey. Our Museum is much indebted to Mr. L. van der Slik, who kindly presented us with some specimens of *Pronucula cancellata*. Together with these all the Narrabeen shells treated below have been added to our Museum Collection. The drawings have been made by the author, with the exception of figures 1a-c which have been copied from Hedley's original figures.

SYSTEMATICS

The material at my disposal is far too limited to serve for an extensive study of the relationship of the species dealt with and of those recorded from other regions. All the species seem to be less than 5 mm in length and have a more or less strong sculpture, except for *Pronucula micans*. For the present I regard the hinge formation as the most important generic feature and the species are treated in an order according to their more or less pronuculid hinge.

---

* Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands.
Manuscript received January, 1967.

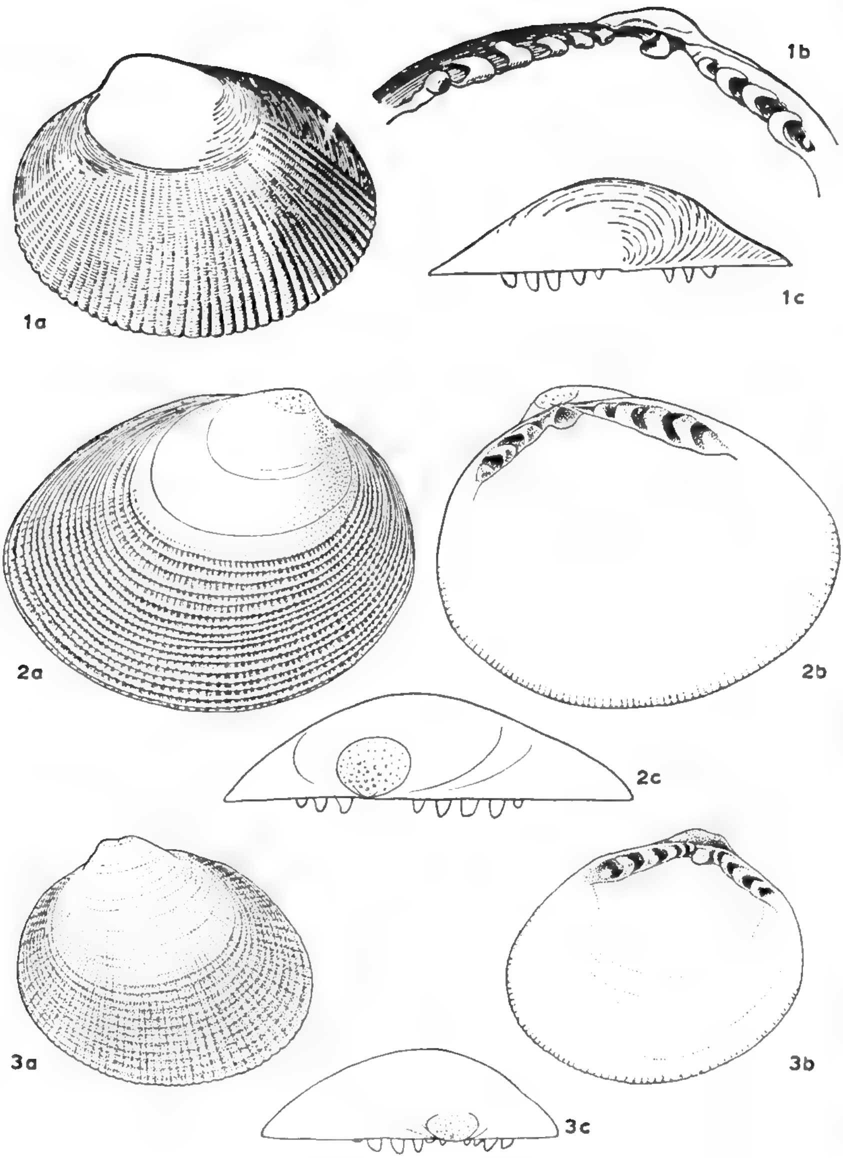


PLATE 11

Fig. !a-c, *Pronucula decorosa* Hedley (after Hedley).
Fig. 2a-c, *Pronucula cancellata* Cotton.
Fig. 3a-c, *Pronucula vincentiana* Cotton & Godfrey

Pronucula decorosa Hedley, 1902

Plate 11, figures 1a-c

Pronucula decorosa—C. Hedley, *Mem. Aust. Mus.* 4, part 5, 1902, p. 290, fig. 39.

Remarks: Although this species is not represented in the material studied by me, the original figure is copied to complete this survey of the New South Wales *Pronucula* species known so far. The following data are taken from Hedley's description. The thin shell is covered by a dense, tough, brown epidermis, on which numerous pustules are irregularly arranged. Beneath the epidermis the shell is white, glossy and brilliantly nacreous. There is almost no sculpture on the umbonal third. About 30 radiating riblets traverse the rest of the valve, except a small anterior and posterior space. (Hedley's figure, however, shows 41 ribs). These are over-ridden by fine, concentric hair lines, which extend on the whole length of the valve. The prodissoconch is conspicuous. The chondrophore is projecting, almost symmetrical and perpendicular, and distant from the teeth. The anterior teeth row has six teeth, the posterior row has five teeth. The pallial line is indistinguishable.
Measurements: length 2.5 mm, height 2 mm, section (single valve) 0.7 mm.

Pronucula cancellata Cotton, 1930

Plate 11, figures 2a-c

Pronucula decorosa Hedley—W. L. May, *Proc. Roy. Soc. Tasm.* 1915, p. 81, plate 8 figs. 42-42a.

Pronucula cancellata sp. nov.—B. C. Cotton, *Rec. S. Aust. Mus.* 1930, Vol. 4 no. 2, p. 224.

Remarks: This species was not yet known from New South Wales. Our small and probably young shells agree with May's illustrations. In outline they resemble *Pronucula hedleyi* but they are much more rounded, the posterodorsal angle, if any, is very obtuse, the shells are less inequilateral and more convex. The embryonic shell is granulated and the umbonal part of the shell is smooth. There is only one difference between our shells and those of May, as described by Cotton: the concentric ribs are much stronger than the radial ribs in stead of being equally valid. All the same the concentrics are slightly thicker where they are crossed by radials, which may give the shell a really cancellated character. Our biggest valve (length 1.60 mm) has 24 concentric ribs. The number of radials increases with the growth and is about the same as in *Pronucula hedleyi*. The radials are rather flat and do not extend on the anterior and posterior parts of the shell. The colour of the epidermis is brownish white or light brown and under it the shells are almost always strongly nacreous, especially near the umbo. Inside the shells are silverish white, and the external concentric sculpture can be seen. The hinge seems to be very much like that of *Pronucula decorosa*. The hinge line is arched, there are few teeth—three in the anterior row and five in the posterior—and the chondrophore is perpendicular and well separating the teeth rows. The teeth are quite heavy, and the hingeplate is relatively broad. Adductor scars and pallial line are indistinct. The ventral margin is crenulated both the interior and the exterior, corresponding with the radial sculpture.
Measurements: Neither May nor Cotton gave the measurements of their

shells. Our figured valve has a length of 1.44 mm, a height of 1.15 mm and a section of 0.38 mm. Our biggest valve measures: length 1.60 mm, height 1.25 mm, section 0.40 mm.

Specimens examined: Four complete shells and two valves dredged at Dolls Point, George's River, 8-10 fathoms, in 1961 or 1962, and also sent to Mr. Van der Slik by Mr. Voorwinde.

Pronucula vincentiana Cotton & Godfrey, 1938

Plate 11, figures 3a-c

Pronucula vincentiana—B. C. Cotton and F. K. Godfrey, *The Molluscs of South Australia, Part I, Pelecypoda*, 1938, p. 38, fig. 7.

Remarks: The valves of this newly recorded species are rather solid, translucent, white or yellowish-white and polished. For about a third of the height the umbonal part of the shell has a smooth appearance. The radial sculpture on this part consists of very delicate striae. These striae may cover the whole umbonal area or only the anterior and posterior parts or even be absent. The embryonic shell is distinguishable by its granulated surface caused by numerous microscopic pits. In younger shells the umbos are bifid. During the growth this feature becomes less distinct because the anterior part of the bifid umbo loses its strongly protruding character. (The figured valve is not yet adult and still has a bifid umbo. For the same reason the discussed umbonal third is relatively too big). The rest of the shell has both radial and concentric ribs. There are over 70 radial ribs, being about as broad as their interstices. These radials extend on the anterior and posterior ends of the shell too, in which respect this species differs from the other species with both radial and concentric sculpture mentioned in this paper. The concentric ribs tend to be somewhat stronger and more pronounced than the radials and they are not too regularly placed, the interstices being sometimes broader than the ribs. The radials and concentrics together build rectangular spaces. The hinge is typically that of a *Pronucula*: the hinge line is arched, there are few teeth and the rows of teeth are separated by a perpendicular chondrophore. The anterior row consists of four V-shaped teeth and the posterior row consists of six teeth, the biggest also V-shaped. The adductor scars are hardly visible and the pallial line is indistinguishable. The ventral and posterior margins are crenulated. The crenulation corresponds with the radial sculpture.

Measurements: of the figured valve, length 1.04 mm, height 0.90 mm, section (single valve) 0.32 mm. Our biggest valve has a (reconstructed) length of 1.3 mm and a height of 1.1 mm. The holotype has a length of 2.5 mm, a height of 2 mm and a section of 1 mm (Cotton & Godfrey, 1938).

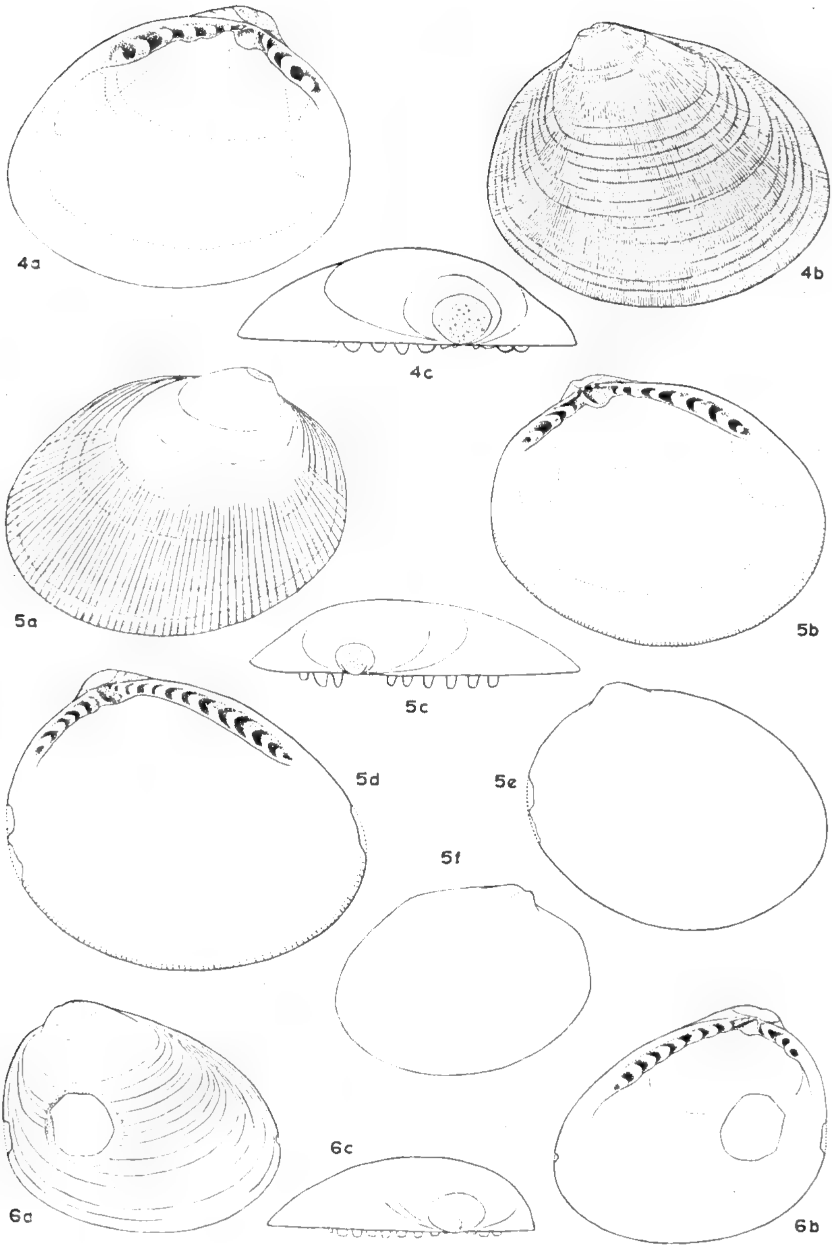
Specimens examined: One complete shell and five odd valves in shell sand, Narrabeen.

PLATE 12

Fig. 4a-c, *Pronucula pusilla* (Angas).

Fig. 5a-f, *Pronucula hedleyi* (Pritchard & Gatliff); a-c, one valve; d, the biggest valve from Narrabeen, somewhat obsolete; e-f, two outlines of other valves.

Fig. 6a-c, *Pronucula micans* (Angas).


4a
4b
4c
5a
5b
5c
5d
5e
5f
6a
6b
6c

Pronucula pusilla (Angas, 1877)

Plate 11, figures 3a-c

Nucula pusilla Angas—G. F. Angas, *Proc. Zool. Soc. Lond.*, 1877, p. 177, plate 26, fig. 26.

Remarks: The outline of this species does not show important variations. The embryonic shell has a granulated structure and in younger shells the umbos are bifid. The radial sculpture consists of numerous very delicate striae, which in most specimens are distinct only on the anterior and posterior parts of the valves. The radial striae are crossed by a great number of growth lines (called "striae" in Angas' description). Some of my shells are pale greenish, most of them are white. The greenish colour is strongest towards the margins, especially the dorsal margin. Inside the colour corresponds with the colour on the exterior. If greenish, this colour is most intensive in the hinge components and the dorsal margin and less towards the other margins. The hinge line is arched and the teeth rows are separated by a perpendicular chondrophore. The anterior row has four distinct teeth and sometimes a fifth, very small, tooth-like projection near the chondrophore. The posterior row has six or seven teeth, the tooth nearest to the chondrophore again being very small. The biggest teeth are V-shaped. In the greenish shells, which I consider to be the most fresh ones, the teeth are rather pointed but not very long. The adductor scars are visible, the pallial line is not. The ventral margin is not crenulated, a feature that this species has in common with *Pronucula micans* (Angas).

Measurements: The figured valve has the following measures: length 1.03 mm, height 0.86 mm and section (single valve) 0.29 mm. The biggest valve in our sample has a length of 1.08 mm and a height of 0.90 mm. The holotype is slightly bigger (Angas, 1877).
Specimens examined: Three complete shells and 43 loose valves in shell sand, Narrabeen.

Pronucula hedleyi (Pritchard & Gatliff, 1904)

Plate 12, figures 5a-f

Nucula minuta—J. E. Tenison Woods, *Proc. Roy. Soc. Tasm.* for 1876, (1877), p. 156.

Pronucula minuta Ten. Woods—C. Hedley, *Mem. Aust. Mus.* 4, part 5, 1902, p. 291, fig. 40.

Nucula hedleyi—G. B. Pritchard and J. H. Gatliff, *Proc. Roy. Soc. Vict.*, 17, (n.s.), 1904, p. 237.

Pronucula hedleyi Pritchard & Gatliff—B. C. Cotton and F. K. Godfrey, *The Molluscs of South Australia, Part I, The Pelecypoda,* 1938, p. 39.

Remarks: Besides the shells from Narrabeen I examined three samples from other localities near Sydney in the Collection Van der Slik and one from Tasmania and another from South Australia in our Museum Collection. In 1904 Pritchard and Gatliff already disagreed with Hedley who in 1902 placed this species in his genus *Pronucula.* Most probably these different views are due to the changes that growing shells of this species undergo, and to the great individual variability. Generally speaking bigger shells are more triangular in form and their hinges are also less pronuculid. Hedley's figure of the hinge, how

indistinct it may be, shows clearly that the chondrophore tends to be oblique. In adult shells with a length of about 3 mm or more—like the valve of figure 5d—the posterior teeth row overlaps the triangular pit in the chondrophore and therewith the anterior teeth row, and moreover there are no edentulous spaces between teeth rows and chondrophore. In smaller valves—still in that of figure 5a-c—there are some minute tooth-like projections immediately beneath the umbo and well separated from the teeth rows by an edentulous space on the hinge plate. The more triangular form of bigger shells is caused by their relatively greater height and by the fact that the posterodorsal angle becomes less distinct during the growth. On the other hand there are young shells without a trace of this angle. The anterior side of the shell is usually subtruncated but this feature too may be indistinct or even absent. The typical form of the species seems to be represented in figure 5a for the halfgrown shells and in figure 5d for the fullgrown ones. The outlines in the figures 5e-f illustrate the variability. They are drawn on the same scale as figure 5a-c, while figure 5d is drawn on a smaller scale. The embryonic shell is white and has a granulated structure. In younger shells the umbo is bifid. The umbonal part, about a fourth of the shell, has only concentric growth lines, no radial sculpture, and is the most translucent part in young shells.

The radial sculpture on the rest of the shell does not extend on the anterior and posterior ends of the shell. The radial ribs are very flat, the interstices are narrow and groove-like. The number of ribs increases with the growth of the shell from about 60 in small shells to about 100 in adult ones. In some shells these ribs are hardly discernible, in others they give the impression as if they are situated under the surface of the shell. In most shells, however, they are distinct towards the ventral margin.

In nearly all valves the growth lines are strongly pronounced on the anterior and posterior parts of the valve. In bigger valves some of these concentric "ribs" near the ventral margin may run over the whole valve surface. Then the radials can be seen only between the concentrics.

The colour of the shells is white or faintly yellowish white and polished and the periostracum is beige-coloured or light brown and shining. Inside the shells are shining white or silverish-white, sometimes nacreous.

The anterior teeth row has from two teeth in specimens with a length of 1 mm to six teeth in adult specimens. The posterior row has respectively from six to twelve teeth. The teeth near the chondrophore are often very small. The biggest teeth are V-shaped. In many cases the adductor scars and the pallial line are difficult to see. The ventral margin is finely crenate, corresponding with the radial sculpture on the exterior.

Measurements: of the valve in figure 5a-c: length 1.91 mm, height 1.56 mm, section 0.46 mm. Measurements of the biggest Narrabeen valve in our collection (figure 5d): length 3.0 mm, height 2.5 mm and section 0.7 mm. According to Cotton and Godfrey the species attains a length of 4 mm.

Specimens examined: One specimen and 17 mostly very young valves in shell sand, Narrabeen. Examined in the Collection Van der Slik: two samples from Dolls Point, George's River, 8-10 fathoms, and one sample from Watson's Bay.

Pronucula micans (Angas, 1878)

Plate 12, figures 6a-c

Nucula micans—G. F. Angas, *Proc. Zool. Soc. Lond.*, 1878, p. 864, plate 54, fig. 16.

Pronucula micans Angas—B. C. Cotton & F. K. Godfrey, *The Molluscs of South Australia, Part I, Pelecypoda*, 1938, p. 40, fig. 12.

Remarks: Although this species was recorded from New South Wales by Cotton and Godfrey (1938), it is not mentioned in the Reference List of this region by T. Iredale and D. F. McMichael (1962). The solid shell is white and polished, both the exterior and the interior. The embryonic shell is finely granulated and the umbo is slightly bifid, which indicates that the valve belonged to a young animal. About two fifths—umbonal—are not translucent, the other part of the shell is more or less translucent. There is no radial sculpture which distinguishes this species from all the other species dealt with. Angas' specimens were "very finely concentrically striated, the striae occasionally running into each other". Cotton & Godfrey stated, however, that *Pronucula micans* has a smooth shell. My valve has some pronounced growth lines, but it is rather smooth than really sculptured.

In my opinion the hinge line is rather angulated as in *Ennucula,* and the chondrophore, although not projecting far beyond the hinge plate, is rather oblique as in *Ennucula* than perpendicular as in *Pronucula.* The adductor scars are only partly visible. I could not distinguish the pallial line. The margins are not crenulated.

Measurements: length 1.18 mm, height 0.99 mm and section 0.27 mm. According to Cotton & Godfrey the species attains a length of 4.5 mm.
Specimens examined: A single valve in shell sand, Narrabeen.

INSTRUCTIONS TO AUTHORS

1. It is the responsibility of authors to prepare papers in a form suitable for publication, and they should consult a current issue in order to familiarize themselves with the practices of the *Journal,* with particular reference to the use of bold-face or italic type, headings, etc.

2. No paper shall be published unless approved by the Editor and the Council and any paper may be submitted to one or more referees before acceptance.

3. Upon acceptance for publication, the paper, including plates, maps, diagrams and all copyrights thereof become the property of the Society.

4. Papers should be double-spaced type-script on one side of the paper only with 1½" margins. The author's name should appear underneath the title with a footnote indicating the address of the institution (if any) to which he belongs and any necessary acknowledgements. A summary of longer papers should be included. The original type-script and one carbon copy should be submitted.

5. As a standard of spelling, the *Journal* uses the *Concise Oxford Dictionary of Current English* (1951, 4th ed., Clarendon Press, Oxford).

6. References should be cited in the text by year of publication, e.g., Leloup (1961) or, if there are several publications by the same author in the same year, Leloup (1961a, 1961b) and they should be arranged at the end of the article in alphabetical order of the authors' names in the following form:

   LELOUP, E., 1961. Species of the Genus *Liolophura* Pilsbry, 1893 (Mollusca, Polyplacophora). *J. Malac. Soc. Aust.,* 5:39-49, pl. 3, text figs. 1-5.

   References to books should give the year of publication, the number of the edition, the name of the publisher and the city of publication. Abbreviations of periodicals should conform with those used in *A World List of Scientific Periodicals* (1952, 3rd ed., Butterworth, London), except that capital initial letters are used throughout, thus "*J. Malac. Soc. Aust.*".

7. Symbols and abbreviations should conform with those recommended in the Royal Society's publication, *General Notes on the Preparation of Scientific Papers* (1950, Cambridge Univeristy Press, London), e.g., all names which are to be printed in italics (such as generic and specific names) must be underlined in the type-scripts.

8. When possible, a proof will be supplied to the author for correction. In general corrections should not include changes from the original text. Such changes may be charged to the author if the Editor deems them to be excessive.

9. A reasonable number of text figures and plates will be reproduced at no cost to the author. Reproduction of special art paper or in colour must, as a rule, be paid for by the author. Full plate size is 6½" by 4" and the maximum width for text figures is 4".

10. Tables should carry a short heading describing the nature of the facts assembled. Both figures and plates, as well as graphs and tables, should be fully comprehensible without reference to the text if possible.

11. New taxonomic units of any kind shall be published only if the description is clearly set out and conforms with the requirements of the *International Code of Zoological Nomenclature* (1961, International Trust for Zoological Nomenclature, London) as amended.

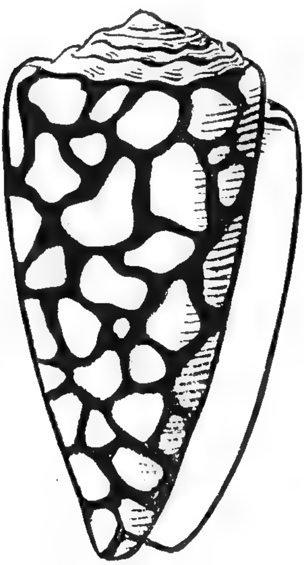
12. Descriptions of new species or subspecies should not be submitted unless arrangements have been made by the author for depositing the holotype with a recognised public Museum, and Museum numbers of the type specimens should be included in the paper. Type localities should be defined as accurately as possible.

13. The Editor reserves the right to make literary amendments, but authors will see any such amendments before publication.

14. Reprints are obtainable by previous arrangement with the Editor. Twenty-five copies are provided free and additional copies will be charged to authors.

JOURNAL OF THE MALACOLOGICAL SOCIETY OF AUSTRALIA

NUMBER 12



Published March 22nd, 1969.

Published annually by the Malacological Society of Australia and obtainable from the Hon. Secretary, c/o. The Australian Museum, P.O. Box A285, South Sydney, New South Wales, 2000. Price $2.00 Australian, £1 Sterling or $2.25 U.S. Complete sets of the Journal are available at special rates.

Registered in Australia for transmission by post as a book.

Mercer Printing Pty. Ltd.
16 Malop Street, Geelong, Victoria, Australia.

AMENDMENTS TO IREDALE AND McMICHAEL'S "REFERENCE LIST OF THE MARINE MOLLUSCA OF NEW SOUTH WALES," 1962.

By

T. A. Garrard

Hon. Associate, Dept. of Molluscs, Australian Museum, Sydney.

INTRODUCTION

Since publication of the "Reference List of Marine Mollusca of New South Wales," descriptions of a number of new species found within the State have been published, and a number of new State records have been noted, in addition to which various errors in the Reference List have been found during searches connected with some species. In regard to new records, I have ignored those which have come to notice through hearsay evidence only, and those discussed below have been included only when the locality in which found is beyond doubt and the specimens have been personally examined and identified.

In checking various recent publications it was found that numerous species have been shown by the authors in different genera from those in which placed in the N.S.W. Reference List; also, especially in *Marine Molluscs of Victoria* (Macpherson and Gabriel, 1962), various family names have been used which are not shown in the Reference List and vice versa, and there are conflicting opinions regarding the placing of certain genera in various families. However, matters such as generic and family transfers can well wait until such time as an Australia-wide reference list is compiled, and at the present time would serve little useful purpose and complicate matters unnecessarily. The following list of amendments is therefore confined to my own personal observations regarding certain species, new records, and typographical errors. Opinions expressed by other authors in the list of references at the end of this paper, or in any other publications, are omitted.

The section of the Reference List dealing with the Subclass Opisthobranchia is to be amended in a separate paper by Mr. Robert Burn of Geelong, Victoria.

AMENDMENTS

Page 7

NUCULIDAE

Add to List *Pronucula micans* (Angas), 1878, *Proc. Zool. Soc. Lond.*, p. 864, pl. 54, fig. 16. Salt Creek, South Australia. In shell sand, Narrabeen, N.S.W. (Bergmans, 1968: 78).

Add to List *Pronucula vincentiana* Cotton and Godfrey, 1938, *The Molluscs of South Australia, Pt. 1, Pelecypoda*, p. 38, fig. 7 in text. Gulf St. Vincent, 20 fathoms. In shell sand, Narrabeen, New South Wales (Bergmans, 1968: 74).

NUCULANIDAE

Genus *Teretileda* Iredale, 1924. Alter date to read 1929.

Add to List *Scaeoleda hanleyi* (Angas), 1873, *Proc. Zool. Soc. Lond.*, p. 184, pl. 20, fig. 7. Twofold Bay, New South Wales. (Gabriel, 1962: 202).

Page 8

LIMOPSIDAE

Aspalima erecta Hedley and Petterd, 1916. Alter date to read 1906.

Page 10

ISOGNOMONTIDAE

Add to List Genus *Parviperna* Iredale, 1939, *Gt. Barrier Reef Exped., Sci. Rep.*, No. 5, p. 322. O.T. *perexigua* Iredale.

Add to List *Parviperna albisoror* Iredale, 1939, *Gt. Barrier Reef Exped., Sci. Rep.*, No. 5, p. 323, pl. 5, figs. 2, 2a. Low Isles, Queensland. Two live taken specimens from Clarence River mouth, New South Wales, in collection G. Dare, Melbourne; ident. T. A. Garrard.

PTERIIDAE

Add to List Genus *Electroma* Stoliczka, 1871, *Pal. Ind.*, (6), fasc. 8, p. 391. O.T. *smaragdina* Reeve.

Add to List *Electroma georgiana* (Quoy and Gaimard), 1835, *Voy. Astrolabe, Zool.*, 3, p. 457. King George Sound, Western Australia. I have collected this species in Twofold Bay, New South Wales. Also Macpherson and Gabriel (1962: 298) state that it is found in New South Wales.

Page 11

PECTINIDAE

Delete species

Mesopeplum caroli Iredale, 1929. I have carefully compared the holotype of this species with that of *M. fenestratum* Hedley, and also with numerous large and small specimens, mature and immature, from various parts of New South Wales, and it is quite obvious that *fenestratum* was named from an immature specimen and *caroli* from a mature shell of the same species. Hedley's name must be given precedence and *caroli* should therefore be deleted from the list.

Add to List Genus *Veprichlamys* Iredale, 1929, *Rec. Aust. Mus.*, 17, p. 164. O. T. *perillustris* Iredale.

Add to List *Veprichlamys perillustris* (Iredale), 1925, *Rec. Aust. Mus.*, 14, p. 254, pl. 41, figs. 3, 4. Off Gabo Island, Victoria, 150-250 fathoms. I have checked and examined records from off Twofold Bay, Merimbula and Bermagui, New South Wales. Also stated by Macpherson and Gabriel (1962: 302) to occur in New South Wales.

Add to List Genus *Chlamys* Roding, 1798, *Mus. Bolten*, 2, p. 161. O.T. *islandicus* Muller.

Add to List *Chlamys schmeltzii* Kobelt, 1888, *Conch. Cab.*, Vol. 7, p. 272, taf. 71, figs. 5, 6.

One live taken specimen from Clarence River mouth, New South Wales, collection G. Dare, Melbourne; ident. T. A. Garrard. Also now examined and recorded from Tryon Island, and 26 fathoms off Lady Musgrave Island, Queensland.

Delete species

Notovola byronensis Fleming, 1955. This subspecies of the Mediterranean *jacobaeus* was named from three single valves presented to the Australian Museum by the late Charles Hedley, collected at Byron Bay, New South Wales. It was separated as a distinct subspecies by Fleming on the grounds that it differed from the typical *fumatus* Reeve from other parts of the New South Wales coast by having nearly all the main ribs divided into three or four riblets, in contrast to the usually plain undivided ribs of *fumatus*, and also by the presence of prominent concentric lamellae, particularly in the intercostal spaces. About six years ago I carefully examined two large sacks of these shells trawled in and around Byron Bay and could find

only three specimens having nearly all the ribs divided, some with just a few divided ribs, and the majority with little or no division; in addition the concentric intercostal lamellae in the majority of specimens became coarser and more prominent towards the ventral margin as maturity was reached. It is fairly obvious that Hedley's three specimens were hand picked because of this unusual feature and otherwise are fairly typical *fumatus*, and separation of the subspecies was not warranted. The name *byronensis* Fleming should be deleted from the List.

AMUSIIDAE

Add to List *Amusium pleuronectes australiae* Habe, 1964, *Bull. Nat. Sci. Mus., Tokyo*, 7, p. 2, pl. 1, figs. 1, 2. Arafura Sea.

One live taken specimen in Australian Museum collection from 40-45 fathoms east of Newcastle, New South Wales; ident. T. A. Garrard.

Page 15

THRACIIDAE

Add to List Genus *Bentholyonsia* Habe, 1952, *Gen. Jap. Shells*, p. 257. O.T. *teramachii* Habe.

Add to List *Bentholyonsia perulae* (Garrard), 1961, *J. Malac. Soc. Aust.*, 5, p. 8, pl. 1, fig. 10. East of Broken Bay, New South Wales, 45 fathoms.

Page 17

CARDITIDAE

Add to List *Cardita crassicosta* Lamarck, 1819, *Hist. Anim. s. Vert.*, 6, p. 24.

Ident. T. A. Garrard from Evans Head and Tweed Heads, New South Wales.

Page 21

CARDIIDAE

Add to List Genus *Meiocardia* Adams, 1857, *Gen. Moll.*, 2, p. 461. O.T. *vulgaris* Reeve.

Add to List *Meiocardia vulgaris* (Reeve), 1845, *Conch. Icon.*, 2, pl. 1, fig. 2. China Seas.

Specimens in Australian Museum collection from 60 fathoms off Coff's Harbour and 45 fathoms off Cronulla, New South Wales. Ident. T. A. Garrard.

Page 22

CIRCIDAE

Redicirce consola Iredale, 1936. Alter page reference from 276 to 277.

Page 24

TELLINIDAE

Alter genus Genus *Tellinota* Iredale, 1936. Replace with *Tellina* Linne, 1758, *Syst. Nat.*, ed. 10, p. 674. In introducing the new genus *Tellinota* the author stated that the type of *Tellina* Linne, 1758, viz., *Tellina radiata* Linne, is " nothing like our species ", referring to the widespread *albinella* Lamarck. On the contrary *radiata*, an American species, differs little from *albinella* in general form, hinge teeth etc., and has the same smooth polished surface, and introduction of the new genus was not justified. Macpherson and Gabriel (1962 : 378) employ the genus *Tellina* Linne.

Alter species *Tellina roseola* (Iredale), 1936. No reason was given by the author in naming this species and in separating it from *albinella* Lamarck, but as the name indicates it is obviously connected with his statement " Coloration practically always rose." I have collected and examined many hundreds of this species from southern Queensland through New South Wales to all southern States, there being practically no differences wherever found apart from the colour, which varies from pure white through shades of cream, yellow, orange, pink and deep rose throughout its range, the deep rose colour predominating. The name *Tellina albinella* Lamarck should therefore be used for this species. Reference: *T. albinella* Lamarck, 1818, *Hist. Anim. s. Vert.*, 5, p. 524. Islands of St. Peter and St. Francis, South Australia.

Macomona tristis (Deshayes), 1855. Alter page reference from 299 to 229.

Page 26

AMPHIDESMATIDAE

Alter genus Genus *Amesodesma* Iredale, 1930. There is no clear-cut evidence that Iredale was the author of this genus, it merely being used as the genus in which to place his briefly described *cuneata vanidica*, and he merely states at the end of the paragraph " Type from Gunnamatta, New South Wales ", and makes no mention that a new genus is being introduced. Macpherson and Gabriel (1962 : 359) make no reference to this genus but give valid reasons for the employment of

Donacilla Blainville, 1819, *Dict. Sci. Nat.*, 13, p. 429. O.T. *donacia* Lamarck. This genus should therefore replace *Amesodesma* Iredale.

Donacilla cuneata vanidica (Iredale), 1930. The date and author's name have been transposed in the List.

Page 29

CHITONIDAE

Add to List Genus *Componochiton* Milne, 1963, *J. Malac. Soc. Aust.*, 7, p. 25. O.T. *raceki* Milne.

Add to List *Componochiton raceki* Milne, 1963, *J. Malac. Soc. Aust.*, 7, p. 25, text figs. 1-5. East of Newcastle, New South Wales, 160 fathoms.

Page 31

HALIOTIDAE

Notohaliotis coccoradiatus (Reeve), 1846. Alter specific name to read *cocoradiatus.*

Page 33

TROCHIDAE

Cantharidella picturata (A. Adams and Angas), 1864. Page reference should read 273.

Page 34

TROCHIDAE

Add to List *Astele bularra* Garrard, 1961, *J. Malac. Soc. Aust.*, 5, p. 10, pl. 2, fig. 5. Off Cape Moreton, Queensland. Further specimens from 50 fathoms east of Broken Bay, New South Wales, in Australian Museum collection.

Page 40

" RISSOIDAE "

Add to List *Lironoba unilirata* (Tenison-Woods), 1878, *Proc. Roy. Soc. Tas.*, p. 123. Tate and May, 1901, *Proc. Linn. Soc. N.S.W.*, p. 394, pl. 26, fig. 79.

One specimen from 60 fathoms off Cronulla, New South Wales; ident. J. Voorwinde.

Add to List Genus *Costabieta* Laseron, 1956, *Aust. J. Marine Freshwater Res.*, 7, p. 421. O.T. *paucina* Laseron.

Add to List *Costabieta paucina* Laseron, 1956, *Aust. J. Marine Freshwater Res.*, 7, p. 421, fig. 87. Michaelmas Cay, Queensland.

Recorded from Port Stephens, Collaroy and Middle Head, Port Jackson, New South Wales; ident. J. Voorwinde.

Page 42

"RISSOIDAE"

Add to List *Microdryas iravadioides* (Gatliff and Gabriel), 1913, *Proc. Roy. Soc. Vict.*, (n.s.) 26, p. 67, pl. 8, fig. 1. Off Wilson's Promontory, Victoria.

Collected at Collaroy, New South Wales; ident. J. Voorwinde.

Page 50

STROMBIDAE

Add to List Genus *Lambis* Roding, 1798, *Mus. Bolten.*, 2, p. 61. T.T. *lambis* Linne.

Add to List *Lambis lambis* (Linne), 1758, *Syst. Nat.*, ed. 10, p. 743, no. 425. Amboina.

One live taken specimen in deep water off Broken Bay, New South Wales. Australian Museum collection.

Page 52

EPITONIIDAE

Genus *Globoscala* Boury, 1909. Alter spelling to *Globiscala.*

Page 56

CASSIDAE (CASSIDIDAE)

Add to List Genus *Echinophoria* Sacco, 1890, *Mem. Accad. Sci. Torino,* (2) 40, p. 503. O.T. *intermedium* Brocchi.

Add to List *Echinophoria wyvillei* (Watson), 1886, *Rep. Sci. Res. Challenger, Zool.*, 25, p. 408, pl. 14, fig. 13. Philippines. 100-115 fathoms.

One specimen in 80 fathoms from cray-pot off Coff's Harbour, New South Wales, in collection G. A. Jarrett, Coff's Harbour; ident. T. A. Garrard. Two other specimens also identified from off Southport and Caloundra, southern Queensland.

Add to List Genus *Pulchroniscia* Garrard, 1961, *J. Malac. Soc. Aust.*, 5, p. 16. O.T. *delecta* Garrard.

Add to List *Pulchroniscia delecta* Garrard, 1961, *J. Malac. Soc. Aust.*, 5, p. 16, pl. 1, figs. 9a, b. East of Botany Bay, New South Wales, 75 fathoms.

Page 57

FICIDAE

Add to List *Ficus filosus* Sowerby, 1893, *Conchologist,* 2, p. 74. Hong-Kong.

Two live taken specimens in 75 fathoms east of Broken Bay, New South Wales (Garrard, 1961 : 17).

NATICIDAE

Add to List *Conuber putealis* (Garrard), 1961, *J. Malac. Soc. Aust.*, 5, p. 18, pl. 2, fig. 6. East of Botany Bay, New South Wales, 50-58 fathoms.

Page 58

NATICIDAE

Propesinum umbilicatum minusculum Iredale, 1924. Delete words "Not figured" and substitute "Figured in Garrard, 1961, *J. Malac. Soc. Aust.*, 5, pl. 2, fig. 3."

Page 61

VOLUTIDAE

Livonia roadknightae (McCoy), 1881. Alter specific name to read *roadnightae.*

Page 62

VOLUTIDAE

Add to List Genus *Pseudocymbiola* McMichael, 1961, *J. Malac. Soc. Aust.*, 5, p. 54. O.T. *provocationis* McMichael.

Add to List *Pseudocymbiola provocationis* McMichael, 1961, *J. Malac. Soc. Aust.*, 5, p. 55. pl. 4, figs. 9, 10. Off Ulladulla, New South Wales.

Page 63

MITRIDAE

Alter species *Vicimitra prosphora* Iredale, 1929. Contrary to the author's remarks when separating this species from *Mitra solida* Reeve, that "Reeve's species is much larger and the cancellation of the upper part of the whorls near the sutures is missing in our species," I have found by study of a large series from southern Queensland through New South Wales to Victoria that both size and cancellations in mature specimens are very variable features, and *prosphora* must be regarded as a synonym of *solida* Reeve. Reference: *Vicimitra solida* (Reeve), 1844, *Conch. Icon.*, 2, *Mitra*, pl. 3, fig. 18. Unknown habitat; Forbes, 1852, *Voy. Rattlesnake*, 2, p. 365.

Alter species *Vicimitra contermina* Iredale, 1936. The name *contermina* was given to this species by the author as at the time he considered it to be nameless, overlooking the prior name of *melaniana* Lamarck, 1811, to which name it should revert. Reference: *Vicimitra melaniana* (Lamarck), 1811, *Ann. Mus. Nat. Hist., Paris,* 17, p. 212.

Alter species *Vicimitra exposita* Iredale, 1936. Examination of a long series of specimens from Port Jackson to Tasmania and South Australia shows that this species is variable regarding the straightness or convexity of the whorls, which are just as variable at the northern as at the southern limits of its range; the ratio of width to length is fairly variable in specimens from the same locality, and mature specimens vary greatly in length throughout its range. The name *glabra* Swainson is used by Macpherson and Gabriel, 1962 : 212, and it is quite apparent that the species is one and the same throughout the whole of its range from Sydney southwards to Tasmania and South Australia. Reference: *Vicimitra glabra* (Swainson), 1821, *Exot. Conch.*, 1, pl. 24; Angas, 1871, *Proc. Zool. Soc., Lond.*, p. 89. New Holland.

Delete species *Vicimitra jervisensis* Laseron, 1951. Delete from List. This species is a synonym of *Microvoluta royana* Iredale, 1924, (Garrard, 1966 : 5). No. 1257 in Reference List.

Alter species *Chrysame lemma* Iredale, 1929. A careful comparison of the holotype of this species with a number of specimens of *Mitra ferruginea* Lamarck shows that it is identical in all respects and typical of the species. Reference: *Chrysame ferruginea* Lamarck, 1811, *Ann. Mus. Nat. Hist. Paris*, 17 p. 200.

Add to List *Chrysame tornata* (Reeve), 1844, *Conch. Icon.*, 2, *Mitra*, pl. 33, sp. 269. Island of Guimaras, Philippines. One specimen from Wooli Beach, New South Wales, collected and ident. T. A. Garrard.

Add to List *Strigatella oleacea* (Reeve), 1844, *Conch. Icon.*, 2, pl. 14, sp. 105. Unknown locality.

One specimen from Wooli Beach, New South Wales, collected and ident. T. A. Garrard.

Add to List *Austromitra bucklandi* Gabriel, 1962, *Mem. Nat. Mus., Melb.*, 25, p. 192, pl. fig. 6. Twofold Bay, New South Wales, 10 fathoms.

Since obtained off Jervis Bay, Port Hacking and Port Jackson, New South Wales; in T. A. Garrard collection.

Page 66

MARGINELLIDAE

Add to List *Volvarinella allporti* (Tenison-Woods), 1876, *Proc. Roy. Soc. Tas.*, 1875, p. 28. Long Bay, Tasmania, 6 fathoms. (One specimen 75 fathoms off Broken Bay, New South Wales, ex "Challenge," and two specimens in 5-10 fathoms in Twofold Bay, New South Wales, collected and ident. T. A. Garrard.)

Page 67

NASSIDAE (NASSARIIDAE)

Alter species *Parcanassa ellana* Iredale, 1936. The author proposed the name *ellana* for this species on the grounds that it differed from *burchardi* Philippi, named from Adelaide, South Australia, by being smaller, longitudinally ribbed, interstices smooth etc. However the Sydney shell differs not at all from many more southerly specimens, Macpherson and Gabriel, (1962 : 195) stating that this smaller form occurs also at Lakes Entrance and Rhyll, Western Port Bay, Victoria. So far as New South Wales specimens are concerned, Botany Bay specimens are a little larger when mature than those from Lane Cove River, whilst Gunnamatta Bay specimens are a little larger still and lighter in colour. Many from the Derwent Estuary, southern Tasmania, are just as small and dark coloured as those from Port Jackson. The species is variable throughout its range and *ellana* must be considered as a synonym of *burchardi* Philippi. Reference: *Parcanassa burchardi* (Philippi), 1849, *Abbild. Beschr.*, 3, p. 69, pl. 2, fig. 14. South Australia.

Alter species *Reticunassa tringa* (Souverbie and Montrouzier), 1864. The name *paupera* Gould, 1850, was used by Hedley for this species in his 1918 Check-list of New South Wales Marine Mollusca, and is still used by Macpherson and Gabriel in Victoria. The reason for the change to *tringa* is not apparent, and Iredale stated when proposing the new genus *Reticunassa* that the Sydney *paupera* Gould was to be the type, and to which name the species should revert. Reference: *Reticunassa paupera* (Gould), 1850, *Proc. Boston Nat. Hist. Soc.*, 3, p. 155. New South Wales.

Alter species *Niotha comtessi* Iredale, 1929. The author separated this new species from the north Queensland *N. gemmulata* (Lamarck) on the grounds that it was larger and with more longitudinal ribs, giving as its range New South Wales and southern Queensland. However although the bulk of north Queensland specimens are somewhat smaller, so also are many mature shells examined from various localities in southern Queensland and northern New South Wales, varying from 20 mm. in length and upwards, compared with 37 mm. in the holotype of *comtessi.* Furthermore the number of ribs on the body whorl varies from as little as 15 to as many as 25 in the holotype, in keeping with similar variations in the more northerly specimens.

Once again this is an example of a very variable species, and it is considered that separation on the grounds of size and number of ribs cannot be sustained, and *comtessi* must be regarded as a synonym of *gemmulata*. Reference: *Niotha gemmulata* (Lamarck), 1822, *Hist. Anim. s. Vert.*, 7, p. 271.

Page 68

FASCIOLARIIDAE

Add to List *Latirus strangei* A. Adams, 1854, *Proc. Zool. Soc. Lond.*, p. 316, no. 21. Levuka, Fiji. 12 fathoms. Watson, 1886, *Rep. Sci. Res. Challenger, Zool.*, 25, p. 245, pl. 14, fig. 4.

One live taken specimen in collection of N. Buckland, Eden, New South Wales, from 60 fathoms off Broken Bay, New South Wales, ex "Challenge"; ident. T. A. Garrard.

Add to List *Latirus thesaurus* Garrard, 1963, *J. Malac. Soc. Aust.*, 7, p. 45, pl. 7, fig. 4. Off Port Hacking, New South Wales, 40 fathoms.

A number of live taken specimens since found by divers in Port Jackson and surrounding area.

ARCHITECTONICIDAE

Delete subspecies *Architectonica perspectiva fressa* Iredale, 1936. The author separated this subspecies from *A. perspectiva* (Linne) on the grounds that it differed in having an additional subsutural brown band, the outer keel being regularly spotted on the underside, sculpture less pronounced, and grooves a little more distant. However my own specimens of the true *perspectiva* from Sabah also have an additional brown band and spotting under the outer keel with sculpture less pronounced than those from southern Queensland. A specimen from the Wessel Islands, north Australia, and another from Ceylon also have the same features. The species is subject to a fair amount of variation in these respects throughout its wide range, and it is considered that the separation of the single Sydney specimen as a distinct and consistent subspecies is not warranted. Reference: *A. perspectiva (Linne)*, 1758, *Syst. Nat.*, ed. 10, p. 3566.

Page 69

FUSINIDAE

Propefusus pyrulatus (Reeve), 1847. Alter plate reference from 3 to 13.

Page 71

MURICIDAE

Alter name *Haustellum espinosus* (Macpherson), 1959. Alter specific name to read *tweedianum* Macpherson. (Macpherson, 1962, *Mem. Nat. Mus. Melb.*, 25, p. 176.)

Alter species *Torvamurex denudatus immunitis* Iredale, 1936.
Torvamurex extraneus Iredale, 1936.

I have already shown (Garrard, 1961 : 27) that the subspecies *immunitis* Iredale must be regarded as a synonym of *T. denudatus* (Perry), and for much the same reasons, the extreme variability of the fronding of the varices and the variation in single and double inter-variceal nodules, sometimes alternately on one specimen, the form *extraneus* must also be regarded as a synonym of *denudatus*. The above species and subspecies were based on variations which occur in many specimens right throughout the extensive range of *denudatus*, in both shallow and fairly deep water, from southern Queensland to Victoria and Tasmania. Reference: *T. denudatus* (Perry), 1811, *Conchology*, p. 7, fig. 2. Port Jackson, New South Wales. (Angas).

Page 74

THAISIDAE

Add to List *Mancinella echinata* (Blainville), 1832, *Nouv. Ann. Mus. Hist. Nat. Paris*, 1, pl. 11, fig. 2.

One specimen in 30 fathoms off Tweed Heads, New South Wales, collected and ident. T. A. Garrard; presented to Australian Museum, Sydney.

TEREBRIDAE

Alter genus *Terebra fictilis* Hinds, 1844.

Terebra assimilis Angas, 1867.

Terebra bicolor Angas, 1867.

These three species appear to have been shown under the genus *Terebra* s.s. in error. The type for the genus, *subulata* Linne, apart from its far larger size, has no impressed or incised line below the sutures nor any sign of subsutural nodules, the only sculpture being faint growth striations. The above three species are better placed in the genus *Pervicacia* Iredale, below, to the type of which they bear a fairly close general resemblance.

Page 75

TEREBRIDAE

Alter species *Dimidacus exultus* Iredale, 1931. I have carefully compared the holotype of this species with a number

of typical specimens of *cingulifera* Lamarck from northern Queensland, Fiji and New Guinea, and they are identical. Reference: *D. cingulifera* (Lamarck), 1822, *Hist. Anim. s. Vert.*, 7, p. 289.

Delete species *Dimidacus melamans* Iredale, 1929. I have carefully compared the holotype of this species with a number of typical specimens of *albomarginatus* Deshayes from southern Queensland and the two species are identical. The species *melamans* should be deleted from the List.

Alter species *Diplomeriza vallesia* (Hedley), 1912. The holotype and paratypes of this species have been compared with numerous specimens of *Diplomeriza bernardi* (Deshayes), 1857, from Queensland and northern New South Wales and they must be considered as synonymous. *D. bernardi* is a most variable species, the length/width ratio varying from 18% to 24%, the coloration varies from off-white to light reddish-brown and a fairly deep slate-grey, the colour band is found at the top, centre or bottom of the whorls, whilst the whorls vary in convexity. The dark brown coloration of the apical whorls and the impressed ledge below the sutures are fairly constant features. Reference: *D. bernardi* (Deshayes), 1857, *J. Conch., Paris,* 6, p. 84, pl. 4, fig. 10. Australia.

Add to List *Triplostephanus lima* (Deshayes), 1857, *J. Conch., Paris,* 6, p. 69, pl. 4, fig. 2. China Seas.

One live taken specimen from off Trial Bay, New South Wales, and two from 58-65 fathoms east of Caloundra, Queensland, in my collection. *T. cumingii* (Deshayes) also from China Seas and Japan appears to be the same species, lacking only the suffused reddish colouration.

CONIDAE

Add to List *Cylindrus omaria* (Bruguiere), 1792, *Ency. Meth. Vers.*, 1, p. 743. Indian Ocean.

One live taken specimen from Minnie Waters, northern New South Wales, taken by Mr. Keith Busch of Grafton, May 1963. Colour slide of specimen by Mr. Geoff Biddle of Grafton held in Australian Museum, Sydney.

Add to List *Rhizoconus advertex* Garrard, 1961, *J. Malac. Soc. Aust.*, 5, p. 30, pl. 1, fig. 1. Off Moreton Island, Queensland. 80 fathoms.

Several live taken specimens recorded from 25-30 fathoms off Evans Head and Ballina, New South Wales.

Add to List Genus *Leptoconus* Swainson, 1840, *Treat. Malac.*, p. 312. L.T. (Herrmannsen, 1847, *Ind Gen. Malac.*, 1, p. 584) *amadis* Martini (= *amadis* Gmelin).

Add to List *Leptoconus illawarra* Garrard, 1961, *J. Malac. Soc. Aust.*, 5, p. 31, pl. 1, fig. 2. East of Stanwell park, New South Wales, 75 fathoms.

Add to List Genus *Mamiconus* Cotton and Godfrey, 1932, *S. Austr. Naturalist*, 13, p. 69. O.T. *superstes* Hedley.

Add to List *Mamiconus minnamurra* Garrard, 1961, *J. Malac. Soc. Aust.*, 5, p. 32, pl. 1, figs. 4a, b. East of Botany Bay, New South Wales, 60 fathoms.

Page 76

CONIDAE

Add to List *Floraconus wallangra* Garrard, 1961, *J. Malac. Soc. Aust.*, 5, p. 29, pl. 1, fig. 3. East of Stanwell Park, New South Wales, 75 fathoms.

TURRIDAE

Subfamily TURRINAE

Add to List Genus *Unedogemmula* MacNeil, 1960, *U.S. Geol. Surv. Prof. Paper* 339, p. 101, O.T. *unedo* Kiener.

Add to List *Unedogemmula unedo* (Kiener), 1839-40, *Coq. Viv.*, 5, p. 19, pl. 14, fig. 1. " mers de l'Inde."

One specimen off Broken Bay, New South Wales, 75 fathoms. (= *binda* Garrard, 1961 : 32; see Powell, 1966 : 48).

Add to List Subfamily TURRICULINAE

Add to List Genus *Comitas* Finlay, 1926, *Trans. N.Z. Inst.*, 56, p. 251, O.T. *oamarutica* Suter.

Add to List *Comitas murrawolga* (Garrard), 1961, *J. Malac. Soc. Aust.*, 5, p. 33, pl. 1, fig. 8. East of Broken Bay, New South Wales, 75 fathoms.

Page 83

ONCHIDIIDAE

Onchidium damelii Semper, 1882. Original spelling is *damelii* which must be altered to daemelii under Article 32 (c) (i) of the International Code.

Page 84

ODOSTOMIIDAE

Add to List *Herviera magis* Laseron, 1959, *Aust. J. Mar. Freshwater Res.*, 10, p. 212, fig. 83. Lindeman Island, Queensland.

Identified from Port Stephens, New South Wales, by J. Voorwinde.

Page 85

"PYRAMIDELLIDAE"

Subfamily TURBONILLINAE

Pyrgiscus varicifer (Tate), 1898. Alter spelling of specific name to read *varicifera.*

Page 87

RETUSIDAE

Retusa apicina Gould, 1859. Alter plate reference in penultimate line to read 49.

Page 100

ARGONAUTIDAE

Add to List *Argonauta argo* Linne, 1758, *Syst. Nat.*, ed. 10, p. 708. One specimen in good condition washed up on beach just north of entrance to Twofold Bay, New South Wales, about 1947, in possession of Mrs. Warren of Eden, New South Wales; ident. T. A. Garrard.

REFERENCES

BERGMANS, W., 1968. A Survey of the species of the Genus *Pronucula* in New South Wales. *J. Malac. Soc. Aust.*, 11: 71-78.

GABRIEL, C. J., 1962. Additions to the Marine Molluscan Fauna of South Eastern Australia. *Mem. Nat. Mus., Vict.*, 25: 177-210.

GARRARD, T. A., 1961. Mollusca collected by m.v. 'Challenge' off the East coast of Australia. *J. Malac. Soc. Aust.*, 5: 2-37.

———, 1966. New species of Mollusca from Eastern Australia (Part 2) with notes on some known species. *J. Malac. Soc. Aust.*, 10: 3-12.

IREDALE, T. and D. F. McMICHAEL, 1962. A Reference List of the Marine Mollusca of New South Wales. *Mem. Aust. Mus.*, 11: 1-109.

MACPHERSON, J.H. and C. J. GABRIEL, 1962. *Marine Molluscs of Victoria.* Melbourne University Press, 475 pp.

POWELL, A. W. B., 1966. The Molluscan Families Speightiidae and Turridae. *Bull. Auck. Inst. Mus.*, 5: 1-184, 23 plates.

REINSTATEMENT OF *EPITONIUM (PAPYRISCALA) TENELLUM* (HUTTON) (GASTROPODA: EPITONIIDAE) TO EASTERN AUSTRALIAN MOLLUSCAN LISTS.

By

Joy Kerslake

53 Alvie Road, Mt. Waverley, Victoria.

Plate 1

SUMMARY

The *Epitonium* species listed currently in Australia as *Limiscala helicornua* Iredale (1936) is considered identical with the New Zealand species *Scalaria tenella* Hutton (1885).

INTRODUCTION

In Iredale's revision of the New South Wales species of the family Epitoniidae (1936), the shell formerly known as *Epitonium tenellum* (Hutton), was re-named *Limiscala helicornua.* Since then much more material has become available for study and a clearer picture of its range and variation has emerged.

In comparing the Sydney shell with the New Zealand *tenellum*, Iredale gives three points of difference: the N.Z. shell is " . . . . smaller, and with fewer ribs and also narrower." Comparison of about 100 eastern Australian shells with a series from New Zealand shows that these differences do not exist.

DESCRIPTION

Epitonium (Papyriscala) tenellum (Hutton)

Pl. 1, figs. 1-6

Scalaria tenella Hutton, 1885: 943.

Scala tenella Gatliff, 1907: 32.

Epitonium tenellum Hedley, 1918: M65.

Limiscala helicornua Iredale, 1936: 299, pl. 22, fig. 11; Iredale and McMichael, 1962: 51; Macpherson and Gabriel, 1962: 115, fig. 142.

As there are several species of small, brown-banded *Epitonium* occuring in New South Wales and Queensland, it may be useful to mention some of the characters by which *tenellum* can be

recognised. It is moderately elongated with a base colour of pale buff except on the area surrounding the umbilicus, where it is usually whitish. The whorls are encircled by three brown bands of very variable intensity of colour. One occurs at the suture, the next is around the periphery of the whorl and the third encircles the shell a little above the umbilical hole. This third band is always the most conspicuous, being thicker and darker. Frequently, on faded dead shells, this is the only band still visible. Towards the northern end of its range in Queensland (Keppel Bay, so far as is known to date), this band is less clearly defined than in the southern shells. In this area, too, the shells are usually smaller. The ribs are creamy-white, uneven in thickness and cordlike or flattened; never sharp.

Number of Ribs:

In support of my contention that the N.Z. shells do not have fewer ribs than those from Australia, I list below the average count per whorl for a number of N.Z. locations compared with one from each of our eastern states. Only mature shells were used.

Location	Numbers of Shells Counted.	Average Number of Ribs.	Range of Rib Count.
NEW ZEALAND			
Matakana Is., Bay of Plenty	31	22	(20-26)
(All of these shells are slightly larger in size than those from other New Zealand locations.)			
Auckland	12	18	(17-21)
Kauri Pt., Manukau Harbour	5	19	(15-22)
Orua Bay, Manukau Harbour	5	17	(16-19)
Mercury Bay and Long Bay, Auckland	9	20	(17-22)
VICTORIA			
Port Albert	9	17	(14-25)
NEW SOUTH WALES			
Port Hacking	16	18	(15-24)
QUEENSLAND			
Zilzie, Keppel Bay	15	18	(14-23)

Shell Proportions:

The illustrations and measurements on Plate 1 provide evidence of the similarity of proportions of shells from a range of locations.

Australian Locations of Material Examined:

VICTORIA: Western Port Bay, dredged in 6-8 fathoms; Port Albert; Mallacoota Inlet. NEW SOUTH WALES: Twofold Bay; Bateman's Bay; Port Hacking; Botany Bay; Sydney Harbour; Pittwater, Broken Bay; Swansea; Port Stephens. QUEENSLAND: Sandgate, Clontarf and Margate, all near the mouth of the Pine River, Moreton Bay; Dundowran Beach, Hervey Bay; Bundaberg; Quoin Island, Port Curtis; Zilzie, Keppel Bay.

Habitat:

It will be noted that the above locations are sheltered areas, frequently inlets at the mouth of rivers, where there is usually a mixture of mud and sand in the habitat. Dr. Powell has told me that the N.Z. *tenellum* lives in a similar situation.

Sub-Generic Placement:

I am doubtful if Epitoniums are sufficiently understood to justify the use of many of the genera and sub-genera that have been erected for them. However, if separation must be made, this species appears to be more accurately placed in the sub-genus *Papyriscala* de Boury, 1909, than in *Limiscala* de Boury, 1909, chosen by Iredale. The type species of *Papyriscala* is *Scalaria latifasciata* Sowerby, 1874, which closely resembles *tenellum* in shape, ribs and shell texture. On the other hand, *Limiscala* has as type the tropical species, *lyra* Sowerby, 1844, a light, frail shell with fine, microscopic revolving sculpture. Its ribs are extremely thin, blade-like and approximately twice as numerous as those of *tenellum*.

Acknowledgements:

Amassing sufficient material to determine even one species of *Epitonium* is a lengthy task. Collectors who have generously helped with this are Mrs. M. Bowman, Mrs. D. Brown, Mrs. E. Harris, Mr. V. Christensen and Mr. John Laseron.

I am also grateful to Dr. D. F. McMichael and Mr. R. Burn for assistance in the preparation of this paper and to Dr. A. W. B. Powell of the Auckland Institute and Museum for the loan of comparative shells from New Zealand.

REFERENCES

BOURY, E. de, 1909. Catalogue des Sous-Genrés de Scalidae, *J. Conch., Paris,* 57: 258.

GATLIFF, J. H., 1907. Additions to the Catalogue of the Marine Shells of Victoria. *Proc. R. Soc. Vic.,* (n.s.) 20: 32.

HEDLEY, C., 1918. A Check List of the Marine Fauna of New South Wales. Part 1. Mollusca. *J. R. Soc. N.S.W.*, 51 (suppl.): M65.

HUTTON, F. W., 1885. Revision of the Marine Taenioglossate and Ptenoglossate Mollusca of New Zealand. *Proc. Linn. Soc. N.S.W.*, 9: 943.

IREDALE, T., 1936. Australian Molluscan Notes. No. 2. *Rec. Aust. Mus.* 19: 299, pl. 22, fig. 11.

IREDALE, T. and D. F. McMICHAEL, 1962. A Reference List of the Marine Mollusca of New South Wales. *Mem. Aust. Mus.,* 11: 51.

MACPHERSON, J. H. and C. J. GABRIEL, 1962. *Marine Molluscs of Victoria.* University of Melbourne Press, Melbourne p. 115, fig. 142.

SOWERBY, G. B., 1844. Descriptions of new species of Scalaria collected by Mr. H. Cuming, to be figured in the fourth part of Thesaurus Conchyliorum. *Proc. Zool. Soc. Lond.,* 12: 13.

———, 1874. *Conchologia Iconica,* 19, sp. 117.

EXPLANATION OF PLATE 1

Epitonium tenellum (Hutton) from various localities.

1-2. Sydney Harbour, New South Wales. Holotype of *Limiscala helicorua* Iredale, 1936, Australian Museum reg. no. C.60649; photographed by C. V. Turner, Australian Museum.

3. Auckland, New Zealand. Length 12.8 mm. J. Kerslake collection.

4. Bundeena, Port Hacking, New South Wales. Length 11.0 mm. J. Kerslake collection.

5. Zilzie, Keppel Bay, Queensland. Length 11.0 mm. J. Kerslake collection.

6. Western Port Bay, Victoria. Length 10.4 mm. J. Kerslake collection.

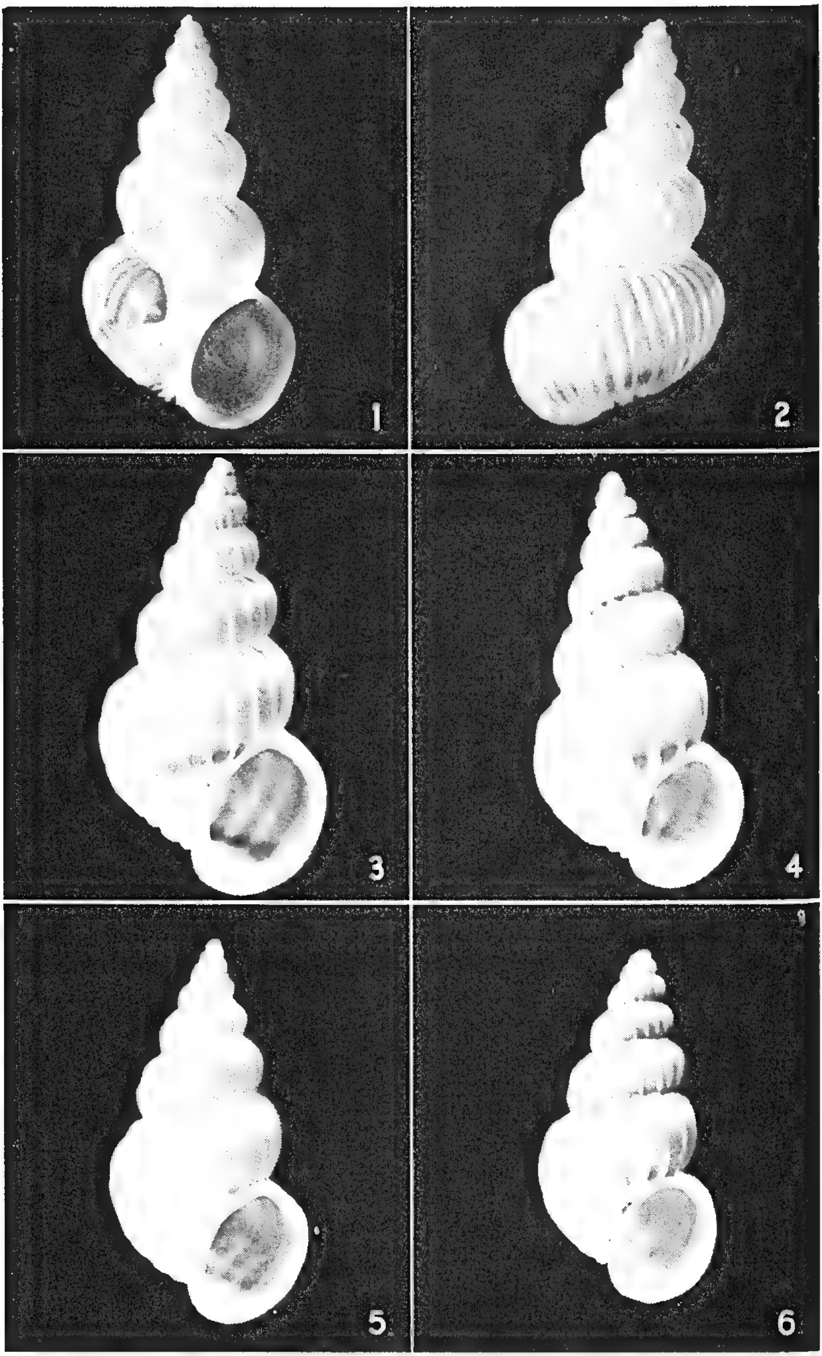


Plate 1

Epitonium (Papyriscala) tenellum (Hutton)

A NEW GENUS, *CALDUKIA*, AND AN EXTENDED DESCRIPTION OF THE TYPE SPECIES, *PROCTONOTUS? AFFINIS* BURN, 1958 (MOLLUSCA GASTROPODA: ARMINACEA, ANTIOPELLIDAE)

By

Robert Burn

Hon. Associate, National Museum of Victoria, Melbourne.

and

M. C. Miller

Department of Zoology, University of Auckland, Auckland.

Plate 2, Text Figures 1 and 2.

SUMMARY

A new genus, *Caldukia* (Arminacea, Pachygnatha, Antiopellidae) is described for the wide-spread south-eastern Australian species, *Proctonotus? affinis* Burn, 1958. Special diagnostic characters of the genus are the lamellate rhinophores, a few huge teeth on the jaws, and cuspidate radular teeth.

INTRODUCTION

Both writers recognized at much the same time that a new genus was desireable for a group of Australian and New Zealand species of which *Proctonotus? affinis* Burn 1958 was presently the only described species. In order to establish the concept of the new genus, *Caldukia,* the Australian species has been selected as the type and is here described in detail. Its relationship with other arminaceans is discussed.

Two New Zealand species will be described in the near future by one of us (M. C. M.); one of these species is very close to the Australian type.

DESCRIPTION

Caldukia gen. nov.

Typically antiopellid in basic organization; distinguishable from other genera of the Antiopellidae by the following characteristics. Rhinophores with a very short peduncle; proximal section stout with up to four sloping laminae, upper and lower surfaces of

these divided into leaflets which are arranged alternately; distal section narrow, cylindrical and truncate. No inter-rhinophoral crest. Radular formula 6.1.6; rhachidian small, hollowed posteriorly, with a blunt median cusp; laterals strongly cuspidate with a stout base and a crown of up to four cusps. Jaws strong and large; unequal, left larger; right jaw with up to four strong teeth, left usually with two; without a middle piece.

Type species by monotypy: *Proctonotus? affinis* Burn, 1958.

The generic taxon, *Caldukia*, is derived from the Australian aboriginal word 'Kalduke' meaning a bunch of feathers, in allusion to the cerata of the living slugs.

Caldukia affinis (Burn).

Proctonotus? affinis Burn, 1958; 32, text fig. 8, pl.7, fig. 15; 1966: 278.

Material examined: VICTORIA; Torquay, 7 December, 1957, two specimens; Point Lonsdale, 18 November, 1963, three specimens and 21 December, 1964, one specimen: NEW SOUTH WALES; Minnie Waters, near Grafton, November, 1963 (collected by Don McMichael and party).

Habitat: under stones in the Sublittoral fringe.

Morphology (Plate 2; fig. 1, A). See original description for features not mentioned here. Length, extended, up to 15mm. Body lanceolate in outline (broad, rounded end at the front), fairly low slightly arched. Pericardium a prominent elliptical swelling in the middle of the notum. Oral tentacles small, blunt, triangular lobes. Rhinophores (Fig. 1, C) with a very short peduncle; proximal two-thirds stout with up to four, large, sloping laminae, the upper and lower surfaces of a lamina are ridged transversely and these ridges or leaflets are arranged alternately; distal third is narrow, cylindrical and truncate. Cerata fusiform, non-caducous, in up to five longitudinal, staggered rows; cerata smallest at the edge of the notum, becoming progressively larger towards the centre. Anus at the tip of a large papilla situated in the mid-line near the rear of the notum. Reproductive apertures on the right side, just below the edge of the notum and about midway between the rhinophores and the front of the pericardium. Renal aperture on the right side, just below the edge of the notum and about level with the posterior end of the pericardium.

Colour. See original description.

Alimentary System (Fig. 1, B). Oral tube short and wide, leads to the buccal mass which is massive, ovate in outline (when viewed from above) and flattened dorso-ventrally. The salivary glands are huge folliculose bodies which lie close to the sides of the oesophagus and the ventrolateral walls of the stomach; the ducts enter the buccal mass on either side of the oesophagus. The oeso-

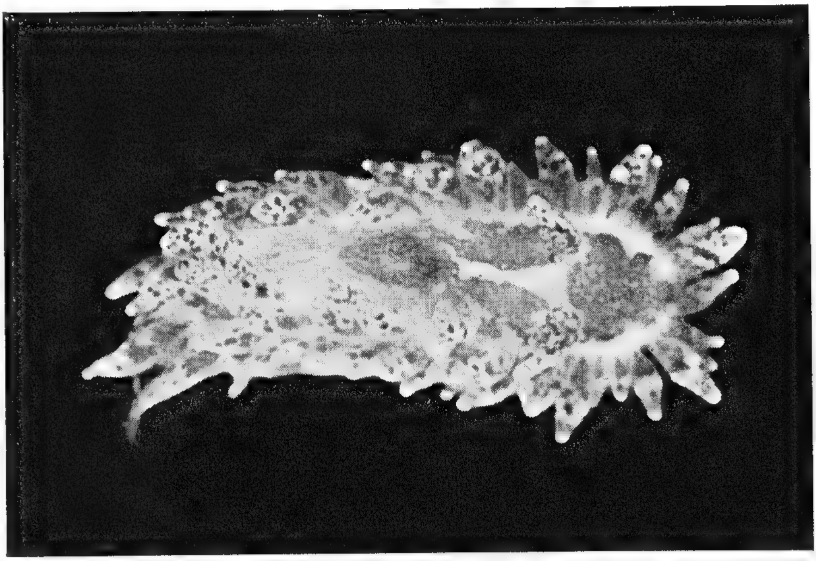
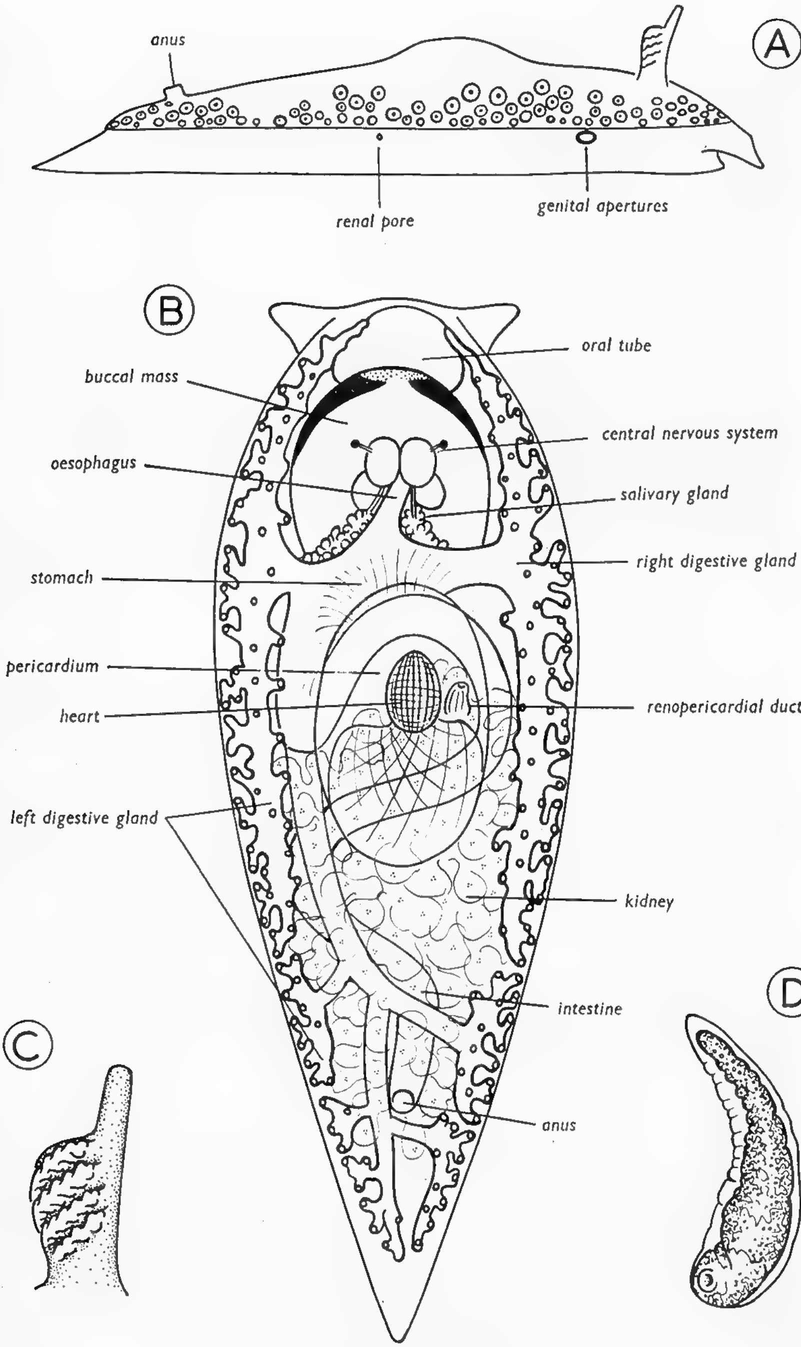


Plate 2. *Caldukia affinis* (Burn). A specimen from Long Reef, New South Wales. Photographed in colour by A. Healy, black and white print by G. Batt.

phagus, which is wide and muscular, leads into a large, crescentic (in outline), muscular stomach. There are three main (stomachal) ducts of the digestive gland; the right and left anterior ducts are extremely short and each forms a T-junction with a large longitudinal duct which runs along the edge of the anterior two-thirds of the notum. Lateral branches, simple or divided, arise along both the inner and outer edges of the longitudinal duct. The left posterior duct is long; it arises close behind the opening of the left anterior duct, runs down the left side of the gonad for a short distance and then gradually curves over to the right — here it gives off, to the left, the first lateral duct. On reaching the mid-line, the main duct sends out the first right lateral duct; the main duct then bends to run posteriorly, parallel with the intestine. More lateral branches issue from the left side of the main duct. Immediately behind the anus a large branch is given off to the right. Like the main anterior ducts, all but the most posterior of these lateral ducts run into a longitudinal duct which gives off short lateral branches. Diverticula to the cerata arise singly from the longitudinal ducts and side branches. The diverticulum (Fig. 1, D) is simple and extends almost to the tip of the ceras. The intestine arises on the left side from the posterior end of the stomach; it bends immediately through 180 degrees and then curves sharply to the right below the front of the pericardium. On the right side the



Text Figure 1

intestine continues to bend and passes beneath the hermaphrodite gland to run back to the left side, where it immediately curves round to the top of the gonad, a little distance behind the pericardium, then passes below the first right lateral branch of the posterior duct of the digestive gland and finally straightens out to run along the mid-line to the anus.

Buccal Armature (Fig. 2, A and B). Radular formula 6-1-6. A 15 mm. individual had a radula with 26 (including 8 developing) rows of teeth. Central tooth small, with sides diverging posteriorly and a curved rear edge; posterior face concave, upper edge notched to form a blunt median cusp. First (the innermost) lateral tooth has a rectangular base surmounted with four cusps. Second to fifth laterals have a curved base which is drawn out into a bluntly pointed arm towards the side of the radula. The second lateral has four cusps (a small one to the rear), the third and fourth have three, the fifth has two and the sixth has one — in each the middle cusp is the largest. Except for the sixth (the outermost), all of the teeth resemble the carnassials of members of the mammal order Carnivora. Jaws, strong, unequal, left larger than the right. Right jaw roughly rectangular in outline with four large, dark yellow teeth; left jaw ovate though the lower margin is almost straight, usually with two large teeth. Jaws firmly united above by a thick band of chitin.

Nervous System. Investigated superficially: cerebral and pleural ganglia fused; fairly long optic nerves.

Kidney. Extensive, filling the dorsal region of the body cavity from the middle of the pericardium to the anus. It is highly branched and these branches or pockets are so compacted as to give the organ an alveolate appearance. The renopericardial duct (Fig. 1, B) lies to the right and just within the anterior half of the pericardium; it is fairly large and folded internally.

Reproductive System (Fig. 2, C). Hermaphrodite gland massive, filling most of the body cavity between the stomach and the anus. Follicles large, ovate, opening singly by a narrow duct into the main hermaphrodite duct which in turn runs forward to a globula ampulla. A common duct leaves the right side of the ampulla and bifurcates. The anterior branch is the vas deferens; the first third of this duct is very narrow, the following section is wide and prostatic. The penis (Fig. 2, D) is fairly long, conical and unarmed. The posterior branch of the common duct is the oviduct; there is a swelling near the junction which is probably the fertilization

---

Fig. 1. *Caldukia affinis* (Burn). A, view of the right side showing the insertions of the cerata and the positions of the various apertures; B, dorsal view of the general anatomy (reproductive system not shown); C, side view of a rhinophore; D, a ceras, preserved (stained with borax carmine and cleared in cedarwood oil).

chamber; from this chamber the oviduct, which is very narrow here, curves to the right and opens into the female gland near the opening of the 'vagina', a fairly long duct which connects the spherical bursa copulatrix to the female atrium.

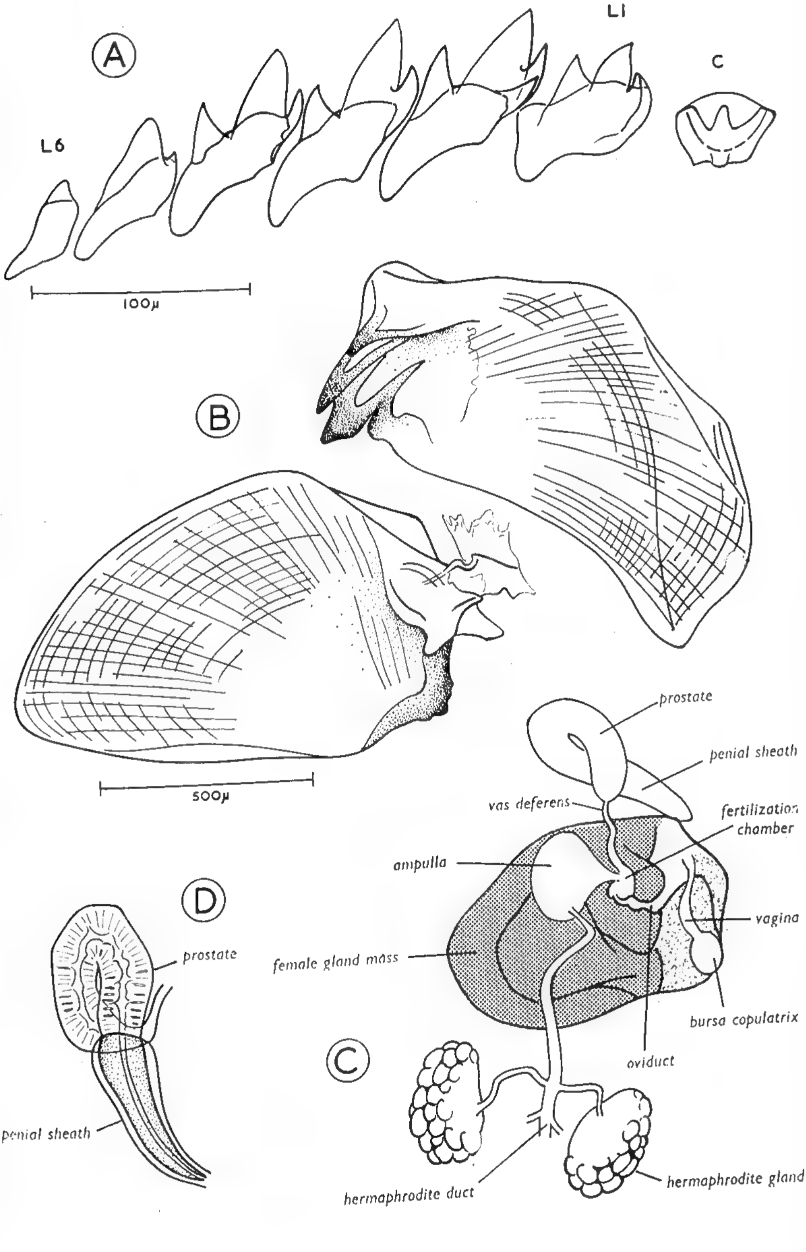
DISCUSSION

Eolidiform bodies, non-retractile laminate, papillate or roughened rhinophores, and thick jaws with large masticatory borders are the characteristics uniting the three families Antiopellidae, Madrellidae and Dironidae into the superfamily Pachygnatha (Odhner, 1939: 48). The first family is separated by the position of the anus in the posterior mid-dorsal line and the presence of the digestive gland in the cerata from the other two families where the anus is lateral to the cerata and the digestive gland terminates at the ceratal base. Smaller numbers of specially adapted teeth in the radulae, 1.1.1 in the Madrellidae and 1.1.1.1.1 in the Dironidae, further separate these families from the Antiopellidae with a greater number of rather uniform smooth, denticulate or cuspidate teeth either side of the naked or dentate rhachis. A seminal vesicle or prostate gland attached by a slender duct to the penial sheath in the Madrellidae does not occur in the other families.

Until now, only three genera have been ascribed to the Antiopellidae; *Janolus* Bergh (1884), *Antiopella* Hoyle (1902; = *Janus* Verany, 1844, = *Antiopa* Alder and Hancock, 1848, both preoccupied), and *Proctonotus* Alder and Hancock (1844; = *Zephryina* Quatrefages, 1843, according to Pruvot-Fol, 1954: 372; = *Venilia* Alder and Hancock, 1844, pre-occupied). Even a family name acceptable to all authors remains in dispute; alternative names used at various times include Janidae, Janolidae, Zephryinidae, and Proctonotidae.

Of the four genera, *Proctonotus* stands somewhat apart, because it lacks an inter-rhinophoral crest (as does also *Caldukia*) and possibly a rhachidian tooth in the radula. *Antiopella* and *Caldukia* have smooth cerata in which the digestive gland is slender and generally branching in the former, and shorter and simple in the latter. *Janolus* and *Proctonotus* have knobbed cerata and simple short digestive glands. The heavy rhinophoral laminae of *Caldukia* are closer to the posteriorly prominent transverse laminae or papillae of *Janolus* than the the slended oblique ribbing of *Antiopella*

Fig. 2. *Caldukia affinis* (Burn). A, radular teeth, a half-row (C, central or rhachidian tooth; L. lateral teeth); B, jaws, view of inner surface (note: left jaw with only one tooth, usually there are two); C, reproductive system, unravelled; D, penis, preserved (stained with borax carmine, cleared in cedarwood oil).



Text Figure 2

and the Dironidae. The rhinophores of the Madrellidae have tubular papillae at the distal anterior side of the stalk, not at mid-length as in the new genus.

The buccal parts have rather uniform jaws, differing only by variation of the masticatory borders; smooth in *Janolus,* small toothed in *Antiopella* and *Proctonotus,* large toothed in *Caldukia.* Radulae too vary only slightly in the older genera; *Proctonotus* has smooth teeth and an inconspicuous or absent rhachidian, *Antiopella* has the rhachidian and at least the first lateral denticulate in all rows, *Janolus* has only the oldest teeth denticulate, adult specimens generally have all teeth smooth in fully developed rows. *Caldukia* has a specialized radula with a virtual three cusped rhachidian and up to four strong cusps on the lateral teeth.

The reproductive systems of the three older genera are insufficiently known to gauge generic characters with any certainty. The male copulatory organ in *Antiopella* is generally a thick conical papilla *(cristata,* Bergh, 1874: pl. 7, fig. 16; *mucloc,* Marcus, 1958: 40, fig. 71; *barbarensis,* MacFarland, 1966: 308, pl. 64, fig. 11, 15) as in *Caldukia.* In at least two species of *Janolus,* this organ is a slender straight papilla *(flagellatus,* Eliot, 1906: 375; *comis,* Marcus, 1958: 34, fig. 61). In three figures of *Antiopella* and one of *Janolus,* the position of the spermatheca or bursa copulatrix varies greatly. It lies at the top or inner end of the vagina in *A. cristata* (Alder and Hancock, 1854: pl. 43, fig. 9) and *A. muscloc* (Marcus, 1958: 40, fig. 71), and at the inner end of the ampulla in *A. barbarensis* (MacFarland, 1966: 307, pl. 64, fig. 11, 13). In *J. comis* (Marcus, 1958: 37, fig. 61), the uterine or insemination duct joins the bursa copulatrix in a 'serial' fashion, that is the vagina and uterine ducts are at opposite sides of the bursal dilation. *Caldukia affinis* has the bursa at the end of a long duct-like vagina, somewhat as in *Antiopella.*

DISTRIBUTION

C. affinis is widespread in south-eastern Australia. In Victoria, it is not uncommon at Torquay and Point Lonsdale and has been collected at Port Fairy and San Remo. It has been rarely taken in New South Wales, at Manly Baths in Sydney Harbour and at Long Reef on the open coast a few miles to the north, and a single specimen was collected at Minnie Waters, east of Grafton on the northern coast. Two Tasmanian specimens are known, both from Greens Beach, Kelso, on the Tamar River. All specimens have been collected either under stones or crawling on algae at low tide level; the food of the species has not yet been established.

REFERENCES

ALDER, J. and A. HANCOCK, 1845 - 1855. *A Monograph of the British Nudibranchiate Mollusca.* London (Ray Society).

BERGH, R., 1874. Beitrage zur Kenntniss der Aeolidiaden. I. *Verh. Zool. Bot. Ges. Wien*, 23 1873): 596-628, pl. 7-10.

BURN, R., 1958. Further Victorian Opisthobranchia. *J. Malac. Soc. Aust.*, 2: 20-36.

———, 1966. Port Phillip Survey 1957-1963. Opisthobranchia. *Mem. Nat. Mus., Melb.*, 27: 265-288.

ELIOT, C., 1906. Notes on some British Nudibranchs. *J. Mar. Biol. Ass. U.K.*, 7: 333-382, pl. 11-12.

MACFARLAND, F., 1966. Studies of opisthobranchiate mollusks of the Pacific coast of North America. *Mem. Calif. Acad. Sci.*, 6: 1-546.

MARCUS, E., 1958. On Western Atlantic opisthobranchiate gastropods. *Amer. Mus. Novitates*, no. 1906: 1-82.

ODHNER, N., 1939. Opisthobranchiate Mollusca from the western and northern coasts of Norway. *K. Norske Vidensk. Selsk. Skr.*, 1939, no. 1: 1-93.

BIOGRAPHIES, COMBINED BIBLIOGRAPHY and NEW NAMES LIST of JOHN HENRY GATLIFF (1848-1935) and CHARLES JOHN GABRIEL (1879-1963).

by Brian J. Smith

Curator of Invertebrates National Museum of Victoria.

and

J. Hope Black (nee Macpherson)

formerly Curator of Molluscs, National Museum of Victoria.

INTRODUCTION

Collections of marine molluscs from Victorian waters were first made extensively and systematically by French explorers under Captain D'Urville of the *Astrolabe* who visited Western Port Bay in November, 1826. The two ship's surgeons, Quoy and Gaimard, described about 20 species and took others back to France for description by other French zoologists.

From the period of settlement until 1880 no papers were published on the Victorian molluscan fauna although pioneers in other States did, from time to time, receive material from Victoria which they included in discussions of their State faunas. One of the workers to rectify this was John Henry Gatliff who, in 1887, published a paper in the *Victorian Naturalist* entitled "A List of Some of the Shells of the Marine Molluscs found upon the Victorian Coast." This was the start of a period of over three quarters of a century during which the scientific study of Victorian molluscs was dominated by two men, John Henry Gatliff and Charles John Gabriel. During this time these two "amateur" workers, working either alone or in collaboration with each other and other workers, collected, described, classified and catalogued the marine, freshwater and land molluscan faunas of Victoria.

John Henry Gatliff

Gatliff was born in Leeds, Yorkshire in 1848 and came to Australia nine years later where his parents took up residence in Geelong, Victoria. At 18 he entered the Bank of Victoria at Ballarat and later joined the staff of the Commonwealth Bank where he became manager and finally inspector. In this capacity he travelled over a considerable portion of Australia, including Port Darwin from whence he brought back a number of rare and interesting specimens including *Voluta gatliffi* named in honour of him by J. B. Sowerby. After producing some preliminary lists of Victorian

marine molluscs Gatliff commenced a long association with G. B. Pritchard, lecturer in palaeontology and geology at the Working Men's College. Between 1898 and 1906 Pritchard and Gatliff collaborated to publish a "Catalogue of Marine Shells of Victoria" in nine parts and a series of companion papers giving details of the new records, including many new species.

After the completion of the *Catalogue* Pritchard returned to his work on fossils and Gatliff carried on the work of expanding the Victorian list alone. In 1908 he published two joint papers with Charles John Gabriel and this started a long and productive partnership which lasted until Gatliff's death on September 14th, 1935. During this time Gatliff and Gabriel published 27 joint papers in which they described many new species. Gatliff was a very active member of the Field Naturalists Club of Victoria for many years, and was appointed Honorary Conchologist to the National Museum of Victoria in 1933. As well as his life-long work of recording the Victorian marine mollusc fauna, Gatliff is also especially known as the describer of the north Queensland volute *Voluta (Amoria) spenceriana.* He had a very extensive collection of over 7,200 species of molluscs, including many type specimens, which all went to the National Museum of Victoria on his death.

Charles John Gabriel

Gabriel was born on May 28th, 1879, in Victoria Street, Abbotsford, Melbourne, Victoria, the eldest son of Joseph Gabriel, a pharmacist. Joseph Gabriel was himself interested in natural history, was a keen member of the Field Naturalists Club of Victoria and was an honorary collector for the National Museum of Victoria. He instilled this interest into his children and Charles became a member of the F.N.C.V. in 1900 and published his first paper, "Marine Mollusca found near Stony Point, April 1908" in the *Victorian Naturalist* in 1908. The same year he published two joint papers with Gatliff on additions and alterations to the catalogue of marine molluscs of Victoria, a task he continued alone up to his death after the death of Gatliff. He also collaborated with other workers including B. C. Cotton, F. Chapman and J. Hope Macpherson. Apart from his extensive and careful work on the marine molluscs, Gabriel is also known for his pioneering work on the land and freshwater molluscan faunas of Victoria. He was appointed Honorary Curator of Shells at the National Museum of Victoria in 1933, a position which was later changed to Honorary Associate in Conchology. In 1946, when a full-time curator was appointed, he presented all his primary type material to the Museum. In 1958 he was awarded the Australian Natural History Medallion for his outstanding contribution to Australian malacology. He wrote over 50 papers, either himself or in collaboration with others and was preparing others at the time of his death on June 19th, 1963. Even after this he continued to be a great service to

Victorian conchology by willing his entire collection of shells and his extensive library to the National Museum of Victoria. His specimen collection is of incalculable value because of its important scientific material including many secondary types he received from Verco, May, Iredale and others, as well as rare and important specimens he collected himself. However, perhaps his greatest legacy was the textbook and handbook " *Marine Molluscs of Victoria* " which he wrote with J. Hope Macpherson in 1962.

Between them Gatliff and Gabriel wrote and contributed to 84 published works in which they described 5 new genera and 149 new specimens and varieties. The type material for all these new species and varieties is lodged in the National Museum of Victoria.

Combined Bibliography of John Henry Gatliff and Charles John Gabriel.

References marked with an asterisk (*) are papers containing the original publication of a new name.

1883

1. Gatliff, J. H. The Pecten. *Sth. Sci. Rec., 3(10): 231-233.*

1887

2. Gatliff, J. H. A List of Some of the Shells of the Marine Mollusca Found upon the Victorian Coast. Part I. *Vict. Nat.*, 4 (4): 57-60.

1888

3. Gatliff, J. H. A List of Some of the Shells of the Marine Mollusca Found upon the Victorian Coast. Part II. *Vict. Nat.*, 5 (8): 111-114.

1891

* 4. Gatliff, J. H. Description of a New Victorian Cone. *Vict. Nat.*, 7 (11-12): 179.

1898

* 5. Pritchard, G. B. and Gatliff, J. H. On a New Species of Victorian Mollusc, *(Coralliophila wilsoni)*. *Proc. R. Soc. Vict.*, (n.s.) 10 (2): 140-141.

6. Pritchard, G. B. and Gatliff, J. H. Catalogue of the Marine Shells of Victoria. Part I. *Proc. R. Soc. Vict.*, (n.s.) 10 (2): 236-284.

1899

* 7. Pritchard, G. B. and Gatliff, J. H. On Some New Species of Victorian Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 11 (2): 179-184, pl. 20.

8. Pritchard, G. B. and Gatliff, J. H. Catalogue of the Marine Shells of Victoria. Part II. *Proc. R. Soc. Vict.*, (n.s.) 11 (2): 185-208.

* 9. Pritchard, G. B. and Gatliff, J. H. On Some New Species of Victorian Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 12 (1): 100-106, pl. 8.

1900

* 10. Gatliff, J. H. Note on Some Victorian Marine Molluscs. *Vict. Nat.*, 17 (3): 54.

11. Gatliff, J. H. Note on the Type of *Thalotia dubia*, a Shell Described by Tenison-Woods. *Vict. Nat.*, (6): 112-113.

12. Pritchard, G. B. and Gatliff, J. H. Catalogue of the Marine Shells of Victoria. Part III. *Proc. R. Soc. Vict.*, (n.s.) 12 (2): 170-205.

* 13. Pritchard, G. B. and Gatliff, J. H. On Some New Species of Victorian Mollusca, No. 4. *Proc. R. Soc. Vict.*, (n.s.) 13 (1): 131-138, pls. 20-21.

14. Pritchard, G. B. and Gatliff, J. H. Catalogue of the Marine Shells of Victoria. Part IV. *Proc. R. Soc. Vict.*, (n.s.) 13 (1): 139-156.

1902

* 15. Pritchard, G. B. and Gatliff, J. H. Catalogue of the Marine Shells of Victoria. Part V. *Proc. R. Soc. Vict.*, (n.s.) 14 (2): 85-138.

* 16. Pritchard, G. B. and Gatliff, J. H. On Some New Species of Victorian Mollusca, No. 5. *Proc. R. Soc. Vict.*, (n.s.) 14 (2): 180-184, pls. 9-10.

17. Gatliff, J. H. Notes on Perry's "Conchology". *Vict. Nat.*, 19 (5): 75-76.

1903

18. Gatliff, J. H. Additions to the List of Victorian Marine Mollusca. *Vict. Nat.*, 20 (7): 89-91.

* 19. Pritchard, G. B. and Gatliff, J. H. Catalogue of the Marine Shells of Victoria. Part VI. *Proc. R. Soc. Vict.*, (n.s.) 15 (2): 176-223.

* 20. Pritchard, G. B. and Gatliff, J. H. On Some New Species of Victorian Mollusca, No. 6. *Proc. R. Soc. Vict.*, (n.s.) 16 (1): 92-95, pl. 15.

21. Pritchard, G. B. and Gatliff, J. H. Catalogue of the Marine Shells of Victoria. Part VII. *Proc. R. Soc. Vict.*, (n.s.) 16 (1): 96-139.

1904

* 22. Pritchard, G. B. and Gatliff, J. H. Catalogue of the Marine Shells of Victoria. Part VIII. *Proc. R. Soc. Vict.*, (n.s.) 17 (1): 220-266.

* 23. Pritchard, G. B. and Gatliff, J. H. On Some New Species of Victorian Mollusca, No. 7. *Proc. R. Soc. Vict.*, (n.s.) 17 (1): 338-339, pl. 20.

1905

* 24. Gatliff, J. H. Description of Two New Species of Shells of the Genus *Leuconopsis*. *Vict. Nat.*, 22 (1): 12-13.

25. Gatliff, J. H. Catalogue of Victorian Estuarine Univalve Mollusca. *Vict. Nat.*, 22 (1): 13-16.

1906

26. Pritchard, G. B. and Gatliff, J. H. Catalogue of the Marine Shells of Victoria. Part IX. With Complete Index to the Whole Catalogue. *Proc. R. Soc. Vict.*, (n.s.) 18 (2): 39-92.

* 27. Gatliff, J. H. On Some Victorian Marine Mollusca, New Species, and others Little-known. *Proc. R. Soc. Vict.*, (n.s.) 19 (1): 1-4, pls. 1-2.

1907

* 28. Bastow, R. A. and Gatliff, J. H. New Species of Australian Chiton from Queensland, *Enoplochiton torri*. *Proc. R. Soc. Vict.*, (n.s.) 20 (1): 27-30, pls. 3-4.

29. Gatliff, J. H. Additions to the Catalogue of the Marine Shells of Victoria. *Proc. R. Soc. Vict.*, (n.s.) 20 (1): 31-37.

1908

30. Gabriel, C. J. Marine Mollusca found near Stony Point, April, 1908. *Vict. Nat.*, 25 (3): 54-55.

31. Gatliff, J. H. Description of *Voluta (Amoria) spenceriana* sp. nov. from North Queensland. *Vict. Nat.*, 25 (5): 84-85.

* 32. Gatliff, J. H. and Gabriel, C. J. On Some New Species of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 21 (1): 365-367, pl. 21.

* 33. Gatliff, J. H. and Gabriel, C. J. Additions to and Revision of the Catalogue of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 21 (1): 368-391.

1909

34. Gabriel, C. J. Excursion to Stony Point, Western Port. (List of Mollusca additional to previous.) *Vict. Nat.*, 26 (2): 19-20.

* 35. Gatliff, J. H. and Gabriel, C. J. Description of a New Marine Shell of the genus *Larina. (?)*. *Proc. R. Soc. Vict.*, (n.s.) 22 (1): 35-36, pl. 13.

36. Gatliff, J. H. and Gabriel, C. J. Additions to the Catalogue of the Marine Shells of Victoria. *Proc. R. Soc. Vict.*, (n.s.) 22 (1): 37-46.

37. Gatliff, J. H. and Gabriel, C. J. First Record of the Animal of *Voluta mamilla* Gray with Remarks Thereon. *Vict. Nat.*, 26 (8): 117-118, pls. 2-3.

1910

* 38. Gatliff, J. H. and Gabriel, C. J. On Some New Species of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 23 (1): 82-86, pls. 18-19.

39. Gatliff, J. H. and Gabriel, C. J. Additions to the Catalogue of the Marine Shells of Victoria. *Proc. R. Soc. Vict.*, (n.s.) 23 (1): 87-98.

1911

40. Gabriel, C. J. Notes on Exotic Mollusca found at Coode Island, with Lists of Species. *Vict. Nat.* 28 (5): 96-98.

* 41. Gatliff, J. H. and Gabriel, C. J. On Some New Species of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 24 (1): 187-192, pls. 46-47.

42. Gatliff, J. H. and Gabriel, C. J. Additions to and Alterations in the Catalogue of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 24 (1): 193-200.

1912

* 43. Gatliff, J. H. and Gabriel, C. J. On a New Variety (var. *bakeri*) of the Marine Shell *Fasciolaria australasiae* Perry. *Vict. Nat.*, 29 (3): 46-48, pls. 3-4.

* 44. Gatliff, J. H. and Gabriel, C. J. On Some New Species of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 25 (1): 167-168, pl. 9.

45. Gatliff, J. H. and Gabriel, C. J. Additions to and Alterations in the Catalogue of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 25 (1): 169-175.

1913

* 46. Pritchard, G. B. and Gatliff, J. H. On *Natica tasmanica*, Tenison-Woods, and description of a New Species of *Natica*. *Proc. R. Soc. Vict.*, (n.s.) 26 (1): 63-66, pl. 7.

* 47. Gatliff, J. H. and Gabriel, C. J. On Some New Species and Varieties of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 26 (1): 67-70, pl. 8.

48. Gatliff, J. H. and Gabriel, C. J. Additions to the Catalogue of the Marine Shells of Victoria. *Proc. R. Soc. Vict.*, (n.s.) 26 (1): 71-87.

1914

49. Gatliff, J. H. and Gabriel, C. J. List of Recent Victorian *Brachiopoda*. *Vict. Nat.*, 30 (11): 210-214, pl. 11.

* 50. Chapman, F. and Gabriel, C. J. Description of New and Rare Fossils obtained by Deep Boring in the Mallee. Pt. II. Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 26 (2): 301-330, pls. 24-28.

* 51. Gatliff, J. H. and Gabriel, C. J. Alterations in the Nomenclature of Some Victorian Marine Mollusca. *Vict. Nat.*, 31 (5): 82-84.

* 52. Gatliff, J. H. and Gabriel, C. J. On Some New Species of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 27 (1): 94-98, pls. 24-26.

53. Gatliff, J. H. and Gabriel, C. J. Additions to the Catalogue of the Marine Shells of Victoria. *Proc. R. Soc. Vict.*, (n.s.) 27 (1): 99-103.

1915

54. Gatliff, J. H. and Gabriel, C. J. Notes on Some Victorian Species of *Teredo*. *Proc. R. Soc. Vict.*, (n.s.) 28 (1): 115-123, pls. 12-13.

1916

* 55. Gatliff, J. H. and Gabriel, C. J. Description of a New Genus and Two New Species of Victorian Marine Mollusca. *Proc R. Soc. Vict.*, (n.s.) 29 (1): 104-105, pl. 7.

56. Gatliff, J. H. and Gabriel, C. J. Additions to and Alterations in the Catalogue of the Marine Shells of Victoria. *Proc. R. Soc. Vict.*, (n.s.) 29 (1): 106-113.

* 57. Gatliff, J. H. Description of Two New Australian Varieties of Cowries. *Vict. Nat.*, 32 (10): 147-149.

1917

58. Chapman, F. and Gabriel, C. J. On a Shell-bed underlying Volcanic Tuff near Warrnambool; with Notes on the Age of the Deposit. *Proc. R. Soc. Vict.*, (n.s.) 30 (1): 4-14.

59. Gatliff, J. H. and Gabriel, C. J. Additions to and Alterations in the Catalogue of the Marine Shells of Victoria. *Proc R. Soc. Vict.*, (n.s.) 30 (1): 21-23, pl. 3.

1921

* 60. Gatliff, J. H. and Gabriel, C. J. Description of a New *Phasianella, (P. tomlini)*. *Proc. Malac. Soc. Lond.*, 14 (5-6): 173.

1922

61. Gabriel, C. J. The Young Collector. Sea Shells. *Pals (Boys' Weekly)*. Vol. 2, No. 36 (Apr.), p. 847.

* 62. Gatliff, J. H. and Gabriel, C. J. Additions to and Alterations in the Catalogue of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 34 (2): 128-161.

1923

* 63. Gatliff, J. H. and Gabriel, C. J. On a New Marine Bi-Valve Shell, *Hemidonax chapmani*, sp. nov. *Vict. Nat.*, 40 (1): 10, pl. 2.

* 64. Chapman, F. and Gabriel, C. J. A Revision and Description of the Australian Tertiary Patellidae, Patelloididae, Cocculinidae and Fissurellidae. *Proc. R. Soc. Vict.*, (n.s.) 34 (1): 22-40, pls. 1-3.

1925

65. Gabriel, C. J. Land Mollusc, New for Victoria. *Vict. Nat.*, 42 (8): 207.

1926

66. Gatliff, J. H. and Gabriel, C. J. Additions to the Catalogue of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 38: 88-94.

1929

* 67. Gabriel, C. J. Report on Land Shells from Cann River, Victoria. *Vict. Nat.*, 46 (6): 130-134.

* 68. Gatliff, J. H. Alteration in the Name of a Cypraea. *Vict. Nat.*, 46 (6): 136.

1930

* 69. Gatliff, J. H. and Singleton, F. A. On the Relationships between "*Pecten*" *asperrimus* Lamarck and "*Pecten*" *anti-australis* Tate with a description of an allied fossil form. *Proc. R. Soc. Vict.*, (n.s.) 42 (2): 71-77, pls. 2-4.

* 70. Gabriel, C. J. Catalogue of the Land Shells of Victoria. *Proc. R. Soc. Vict.*, (n.s.) 43 (1): 62-88, pls. 2-3.

1931

71. Gatliff, J. H. and Gabriel, C. J. Additions to and Alterations in the Catalogue of Victorian Marine Mollusca. *Proc. R. Soc. Vict.*, (n.s.) 43 (2): 202-232.

1932

* 72. Cotton, B. C. and Gabriel, C. J. Australian Unionidae. *Proc. R. Soc. Vict.*, (n.s.) 44 (2): 155-160, pl. 16.

73. Gabriel, C. J. Freshwater Mussels, (Beechworth Excursion, Easter, 1932). *Vict. Nat.*, 49 (1): 21.

1933

74. Gabriel, C. J. The Victorian "Umbrella Shell", *Umbraculum corticale* Tate. *Vict. Nat.*, 50 (2): 48.

1934

* 75. Gabriel, C. J. *Thalassohelix translucens,* a New Victorian Land Shell. *Mem. Natn. Mus. Vict.*, 8: 157, pl. 18.

1935

76. Gabriel, C. J. John Henry Gatliff — Obituary. *Vict. Nat.*, 52 (6): 117-118.

1936

77. Gabriel, C. J. *Victorian Sea Shells.* F. N. C. V. Handbook, pp. 1-68.

1937

78. Gabriel, C. J. *Humphreyia strangei* A. Adams: A Peculiar Bivalve Shell. *Vict. Nat.*, 53 (10): 171-172.

1939

* 79. Gabriel, C. J. The Fresh Water Mollusca of Victoria. *Mem. Natn. Mus. Vict.*, 11: 100-139, pls. 1-4.

1947

* 80. Gabriel, C. J. Additions to and Alterations in the Catalogue of the Land Shells of Victoria (including Descriptions of New Species). *Mem. Natn. Mus. Vict.*, 15: 109-125, pls. 9-10.

* 81. Gabriel, C. J. and Macpherson, J. H. A Preliminary Report on the Biology and Ecology of the Snowy River area in North-eastern Victoria. Mollusca. *Mem. Natn. Mus. Vict.*, 15: 158-167.

1956

* 82. Gabriel, C. J. Mollusca from South East of King Island, Bass Strait. *Mem. Natn. Mus. Vict.*, 22 (4): 1-16.

1962

* 83. Gabriel, C. J. Additions to the Marine Molluscan Fauna of South Eastern Australia, including Descriptions of New Genus *Pillarginella,* Six New Species and Two Sub-species. *Mem. Natn. Mus. Vict.*, 25: 177-210.

84. Macpherson, J. H. and Gabriel, C. J. *Marine Mollusca of Victoria,* pp. i-xv, 1-475, 486 text figs. Melbourne University Press.

List of New Names Proposed by John Henry Gatliff and Charles John Gabriel.

This list is set out alphabetically according to species, with the original genus name included. The first of the two numbers after each name represents the number of the paper in the bibliography in which the original description appears, the second number is the page number in that publication. After each name, the category of *type* specimen(s) of that species held by the National Museum of Victoria is given, also the N. M. V. Registration Number of the type specimens held. The number in brackets after each paratype entry is the number of paratype specimens of that species that are held by the Museum. Where a new name was introduced to correct the nomenclature of a previously described species, the original name and author have been given.

alternans, Marginella,	7 : 180	Holotype	F 535
aperturata, Montfortula,	64 : 30	Holotype	P 14246
apicilata, Rissoa verconis,	47 : 68	Holotype	F 577
ayresi, Polinices (Conuber),	83 : 185	Holotype	F 20828
		Paratype (1)	F 20829
arenacea, Leptothyra,	16 : 181	Holotype	F 594
bairnsdalensis, Charopa,	70 : 78	Holotype	F 704
bakeri, Fasciolaria australasia,	43 : 47	Holotype	F 617
		Paratype (1)	F 480
bakeri, Cypraea venusta,	57 : 147	Holotype	F 616
bannertonensis, Bifidaria,	70 : 64	Holotype	F 702
		Paratypes (33)	F 703,
			F 631
			F 26927
bassiana, Austromitra bucklandi,	83 : 192	Holotype	F 20729
		Paratypes (2)	F 20730
bassiana, Mithrithara,	82 : 4	Holotype	F 16123
		Paratype (1)	F 16124
bastowi, Cyclostrema,	26 : 3	Holotype	F 555
bastowi, Daphnella,	32 : 365	Holotype	F 602
benthalis, Reticunassa compacta,	83 : 189	Holotype	F 20838
		Paratypes (7)	F 20839
brazenori, Charopa,	81 : 160	Holotype	F 1682
		Paratype (1)	F 1682
brevis, Turbonilla,	13 : 135	Holotype	F 518
bucklandi, Austromitra,	83 : 192	Holotype	F 20727
		Paratypes (2)	F 20728

cainozoica, Montfortula,	64 : 31	Holotype	P 14250
cannfluviatilus, Allodiscus,	67 : 133	Holotype	F 569
chapmani, Condylocardia,	44 : 167	Holotype	F 481
chapmani, Hemidonax,	63 : 10	Holotype	F 512
		Paratype (1)	F 513
chrysalida, Rissoa (Onoba),	50 : 322	Holotype	P 12489
		Paratype (1)	P 12490
cognata, Cithara,	9 : 103	Holotype	F 606
		Paratypes (2)	F 19141
colliveri, Charopa,	80 : 118	Holotype	F 1060
		Paratype (1)	F 1061
controversa, Natica,	46 : 65	Holotype	F 695
cudmorei, Cellana,	64 : 23	Holotype	P 14402
delicatissima, Emarginula,	64 : 26	Holotype	P 14255
dennanti, Chlamys asperrimus,	69 : 73	Holotype (right valve)	P 13503
		Paratype (1)	P 13504
dennanti, Emarginula,	64 : 27	Holotype	P 14256
dennanti, Liotia,	50 : 315	Holotype	P 12477
		Paratype (1)	P 12478
denticulata, Erato,	13 : 133	Holotype	F 524
depressula, Teinostoma,	50 : 317	Holotype	P 12479
difficilis, Dardanula,	82 : 7	Holotype	F 16129
		Paratypes (5)	F 16130
difficilis, Volvarinella,	83 : 196	Holotype	F 20834
		Paratype (1)	F 20835
dilectoides, Pleurotoma (Drillia),	50 : 327	Holotype	P 12494
dromanaensis, Montacuta,	44 : 167	Holotype	F 522
Edenttellina,	41 : 190		
edithae, Ancilla,	7 : 181	Holotype	F 609
		Paratype (1)	F 19139
everardensis, Longinella,	83 : 195	Holotype	F 20830
		Paratype (1)	F 20831
erskinensis, Charopa,	70 : 76	Holotype	F 707
		Paratypes (3)	F 457-9
excavata, Daphnella,	26 : 1	Holotype	F 603
flaccida, Mangilia,	9 : 102	Holotype	F 530
		Paratype (1)	F 19144
flindersi, Marginella,	7 : 180	Holotype	F 612
flindersi, Mitromorpha,	9 : 104	Holotype	F 565
		Paratype (3)	F 19142

franklinensis, Columbella,	38 : 83	Holotype	F 579
frenshiensis, Lepton,	55 : 105	Holotype	F 725
		Paratype (1)	F 1452
frenchiensis, Rissoa,	33 : 379	nom. mut. for *R. cyclostoma* T. Woods. 1877.	
gabensis, Notomella,	83 : 178	Holotype	F 20840
gabrielana, Cypraea miliaris,	68 : 136	nom. mut. for *C. m. gabrieli* Gatliff. 1916.	
gabrieli, Cypraea miliaris,	57 : 148	Holotype	F 445
gabrieli, Drillia,	9 : 100	Holotype	F 556
		Paratypes (2)	F 19143
gabrieli, Trichotropis,	7 : 183	Holotype	F 498
gatliffi, Charopa,	70 : 76	Holotype	F 705
		Paratypes (9)	F 632, F 26926
gatliffiana, Rissoa,	50 : 321	Holotype	P 12487
gemmata, Montfortula,	64 : 32	Holotype	P 14248
		Paratype (1)	P 14249
grampianensis, Bythinella,	79 : 106	Holotype	F 598
granti, Haliotis,	16 : 183	Holotype	F 689
gunyoungensis, Cocculina,	64 : 26	Holotype	P 14260
halli, Marginella,	7 : 179	Holotype	F 559
hamiltonensis, Patelloida,	64 : 24	Holotype	P 14257
hedleyi, Calliostoma,	16 : 182	Holotype	F 520
		Paratypes (2)	F 499, F 500
hedleyi, Liotia,	9 : 105	Holotype	F 522
		Paratypes (5)	F 563, F 1454, F 19135
hedleyi, Nucula,	22 : 237	nom. mut. for *N. minuta* T. Woods, 1877.	
hentyi, Cellana,	64 : 23	Holotype	P 14263
hepatica, Patella,	19 : 194	Holotype	F 446
hoggartae, Estea,	82 : 6	Holotype	F 16127
		Paratypes (2)	F 16128
howitti, Drillia,	9 : 101	Holotype	F 573
illustra, Charopa,	80 : 117	Holotype	F 1056
		Paratypes (9)	F 1057

immaculata, Stylifer,	13 : 137	Holotype	F 553
incerta, Mangilia (?),	16 : 180	Holotype	F 576
inconspicua, Terebra,	16 : 181	Holotype	F 541
inexpectata, Charopa,	80 : 118	Holotype	F 1062
iravadioides, Rissoa,	47 : 67	Holotype	F 523
		Paratype (1)	F 27077
janjucensis, Rissoa,	47 : 67	Holotype	F 570
		Paratype (1)	F 571
jemmysensis, Charopa,	80 : 117	Holotype	F 1054
		Paratypes (18)	F 1055
joshuana, Leiostraca,	38 : 83	Holotype	F 717
kalimnae, Calyptraea,	50 : 320	Holotype	P 12484
		Paratype (1)	P 12485
kenyoniana, Donax,	50 : 312	Holotype	P 12474
		Paratypes (2)	P 12475
			P 12476
kenyoniana, Tellina,	23 : 339	Holotype	F 496
kilcundae, Cyclostrema,	52 : 95	Holotype	F 597
		Paratypes (2)	F 1453
kilcundae, Leiostraca,	52 : 94	Holotype	F 716
kingensis, Cantharidus,	82 : 5	Holotype	F 16125
		Paratypes (4)	F 16126
lakesentranciencia, Charopa,	80 : 119	Holotype	F 1063
		Paratype (1)	F 1064
Larinopsis,	55 : 104		
maccoyi, Cancellaria,	7 : 182	Holotype	F 490
		Paratype (1)	F 19140
macphersonae, Mitrithara,	82 : 3	Holotype	F 16121
		Paratype (1)	F 16122
magna, Cingulina,	38 : 84	Holotype	F 608
malinoides, Triginella,	83 : 195	Holotype	F 20832
		Paratype (1)	F 20833
marysvillensis, Allodiscus,	80 : 122	Holotype	F 1066
maudensis, Emarginula,	64 : 28	Holotype	P 14254
mayi, Lucina,	41 : 189	Holotype	F 726
metcalfei, Odostomia,	13 : 136	Holotype	F 23340
		Paratype (1)	F 5183
micra, Turbonilla (Ondina),	13 : 134	Holotype	F 547
microscopica, Cyclostrema,	38 : 85	Holotype	F 596
multiradialis, Patelloida,	64 : 24	Holotype	P 14259
narracanensis, Propehyridella,	72 : 159	Holotype	F 629
		Paratypes (2½)	F 13734

nepeanensis, Cyclopecten,	23 : 338	Holotype	F 558
		Paratype (1)	F 531
nepeanensis, Phasianella,	32 : 366	Holotype	F 543
		Paratypes (2)	F 25765
nepeanensis, Scala,	26 : 1	Holotype	F 607
nitens, Montacuta,	41 : 191	Holotype	F 511
okeana, Charopa,	80 : 117	Holotype	F 1058
pellucida, Aclis,	41 : 187	Holotype	F 506
petterdi, Odostomia,	10 : 54	nom. mut for *Obeliscus tasmanica* Petterd. 1884.	
Pillarginella,	83 : 197		
pinguicula, Eulima,	50 : 319	Holotype	P 12482
planilirata, Cuna,	41 : 191	Holotype	F 724
		Paratypes (5)	F 605
ponderosa, Montfortula,	64 : 33	Holotype	P 14251
portseaensis, Turbonilla,	41 : 188	Holotype	F 721
praecompressa, Cocculina,	64 : 25	Holotype	P 14261
		Paratype (1)	P 14262
praeformicula, Marginella,	50 : 326	Holotype	F 727
		Paratypes (2)	F 5184
problematica, Charopa,	80 : 119	Holotype	F 1065
		Paratypes (11)	F 22825
problematica, Marginella,	55 : 104	Holotype	F 727
		Paratypes (2)	F 5184
problematicum, Sphaerium,	79 : 128	Holotype	F 529
		Paratypes (6)	F 566, F 584, F 26898
profunda, Terebra,	50 : 326	Holotype	P 12493
Propehyridella,	72 : 158		
Protohyridella,	72 : 159		
pulcherrima, Teinostoma,	50 : 317	Holotype	P 12480
remoensis, Columbella,	38 : 82	Holotype	F 611
rhyllensis, Cingulina,	38 : 84	Holotype	F 713
rhyllensis, Modiolaria,	44 : 167	Holotype	F 728
rhyllensis, Rissoina,	32 : 367	Holotype	F 720
scindocataracta, Charopa,	70 : 77	Holotype	F 708
		Paratypes (3)	F 630, F 1109
sculpta, Bullinella pygmaea,	47 : 69	Holotype	F 712

segravai, Conus,	4 : 179	Holotype	F 491
sexdentata, Clathurella,	9 : 104	Holotype	F 599
		Paratype (1)	F 19137
shorehami, Marginella,	7 : 179	Holotype	F 548
		Paratype (1)	F 19137
shorehami, Natica,	13 : 131	Holotype	F 542
		Paratypes (2)	F 19138
			F 27098
sinistra, Laoma,	70 : 81	Holotype	F 710
		Paratypes (10)	F 532,
			F 1108,
			F 26925
snowyensis, Charopa,	81 : 161	Holotype	F 1673
		Paratypes (12)	F 1673
spenceriana, Voluta (Amoria),	31 : 84	Holotype	F 455
spiraliscabra, Nassa,	50 : 325	Holotype	P 12491
squamoidea, Montfortula,	64 : 33	Holotype	P 14247
subalbida, Myodora,	52 : 96	Holotype	F 488
subalata, Saxicava,	38 : 85	Holotype	F 729
		Paratypes (84 left valves)	
			F 26894
		(71 right valves)	
			F 26894
		(3)	F 1458
styliformis, Leiostraca,	52 : 95	Holotype	F 718
tarravillensis, Charopa,	70 : 77	Holotype	F 706
		Paratypes (2)	F 621
tatei, Leuconopsis,	24 : 13	Holotype	F 550
tenuicostae, Condylocardia,	50 : 309	Holotype	P 12471
		Paratype (1)	P 12472
tomlini, Phasianella,	60 : 173	Holotype	F 567
		Paratypes (29)	F 568,
			F 5189
torri, Enoplochiton,	28 : 27	Holotype	F 16375
		Paratypes (5)	F 17986
			F 16374
translucens, Thalassohelix,	75 : 157	Holotype	F 618
		Paratype (1)	F 489
translucida, Scala,	26 : 2	Holotype	F 509
turbinata, Larina (?),	35 : 35	Holotype	F 711

turbinuloidea, Laoma,	70 : 81	Holotype	F 709
typica, Edenttellina,	41 : 190	Holotype	F 515
vercoi, Cyclostrema,	52 : 96	Holotype	F 604
victoriae, Dosinia,	52 : 96	Holotype	F 722
		Paratype (1)	F 723
victoriae, Eulima,	52 : 94	Holotype	F 714
		Paratype (1)	F 1459
victoriae, Leuconopsis,	24 : 12	Holotype	F 538
victoriae, Marginella,	32 : 365	Holotype	F 593
victoriae, Modiola,	20 : 93	Holotype	F 625
victoriae, Odostomia,	41 : 187	Holotype	F 552
victoriae, Patella,	62 : 152	nom. mut. for *P. hepatica* Prit. & Gat. 1902.	
victoriae, Tellina (Arcopagia),	51 : 83	nom. mut. for *T. decussata* Lamarck 1818.	
victoriae, Zenatia,	20 : 92	Holotype	F 440
weeahensis, Turbonilla,	50 : 320	Holotype	P 12483
whani, Marginella,	13 : 137	Holotype	F 517
wilfredi, Jeffreysia,	41 : 188	Holotype	F 715
		Paratype (1)	F 27076
wilsonensis, Rissoa,	47 : 68	Holotype	F 719
wilsoni, Coralliophila,	5 : 140	Holotype	F 628
woodsi, Rissoa,	15 : 104	nom. mut. for *R. cyclostoma* var. *rosea* T. Woods, 1877.	

CONCHOLOGISTS OF THE PAST

2. George French Angas (1822 - 1886)

By Gilbert P. Whitley

Honorary Associate, The Australian Museum, Sydney.

Plate 3

"The Father of Australian Conchology" was the title bestowed on George French Angas by Tom Iredale when he wrote an account of that artist and naturalist for the *Australian Zoologist* in 1959. Iredale provided there a bibliography of Angas and an index of his new names for molluscs, but he expressed dissatisfaction with the only known portrait of Angas because it showed a somewhat boyish, "delicate-looking artist", whereas Angas was a determined adventurer who had suffered incredible hardships in many parts of the globe. This portrait, reproduced in Iredale and Hull's *Monograph of the Australian Loricates* in 1927, showed the facial portion of a photocopy by Appleby of Sydney of a head-and-shoulders 1848 portrait, still filed with photographs of trustees and senior officials in the Australian Museum's archives. This was again a copy of an almost full-length portrait, (perhaps a self-portrait?), which was lithographed by a London artist in 1848, when Angas was 26 years old. It shows him with his paintbox and brushes, attired for working out-of-doors, as was his wont, with sketchbook and pencil in his hands. This portrait was first published in Angas' *The Kafirs Illustrated*, 1849, frontispiece. It is the same as Portrait P. 3/A in the Mitchell Library, Sydney, and has been reproduced by Pamela Ruskin in *Walkabout*, 1967, and on the cover of A. H. & A. W. Reed's prospectus (1967). Up to now, it was the only known picture of George French Angas. However, on looking through old photograph albums in the Australian Museum, Sydney, I noticed an old photograph of Angas, evidently one which he sent to John Brazier in 1869 (see correspondence, below) and Brazier has written the date of Angas's death, some 17 years later, below it. Angas is shown in London, his silk hat on the table, and even in his forties is not as weatherbeaten as one might expect and his hair is still dark. Through the courtesy of the Museum authorities and the skill of Mr. C. V. Turner of the Department of Photography, a copy of it is here published (pl. 3).

It is to Tom Iredale, too, that we should be grateful for an illuminating anecdote which he uses to introduce his account (1969) of Charles Hedley. In that paper Iredale relates:

"Our first knowledge of Hedley as a conchologist is concerned in the recounting of one of those extraordinary coincidences which occur daily, and yet are inexplicable by the law of averages or chances. Invalided as a youth through asthmatic troubles Hedley was living in the south of France, and there, searching for shells, observed another gentleman who appeared to be engaged in the same unusual pursuit. Such an unexpected occasion invited conversation so Hedley courteously inquired of the other, who appeared to be a dapper Frenchman .... if he were seeking shells. As Hedley had voiced his inquiry in French he was surprised to find himself misunderstood, so, venturing, repeated the question in English to which he got a ready affirmative. Cards were exchanged and the stranger turned out to be George French Angas, the great Australian conchologist, sometime previously Secretary of the Australian Museum. At that meeting Hedley had no thought whatever of coming to Australia, still less of following the calling of conchologist, and had little or no knowledge of the Australian Museum. It was indeed a curious meeting of Elijah and Elisha, each absolutely unconscious of the future relationship, for fate willed it that Angas's List of the Marine Mollusca of New South Wales should be followed nearly fifty years later by Hedley's well known Check-List. It may be emphasized that this meeting with Angas had absolutely no bearing upon Hedley's future movements."

The *Australian Dictionary of Biography* gives an account of George French Angas which is the result of modern scholarship (see Morgan, 1966), whilst Gordon (1940) and Pamela Ruskin (1967) supplied accounts of that pioneer artist. Angas was born and died in England but the number of biographies of him which exist (see References, below) do not agree as to exact days and places, and some contain errors. An artist, he was connected with the British Museum and was appointed Collector in 1847. He was widely travelled and had considerable linguistic attainments, and he accompanied Layard to Nineveh.

Iredale and Hull (1927) stated that Angas was Secretary of the Australian Museum in 1851, but Iredale (1959) and the A. D. B. (Morgan, 1966) say that he was appointed in 1853 and held that position until 1860. From the Australian Museum's Minutes, manuscript Register of Employees, and old Letter Book, I have confirmed that he was appointed Secretary and Accountant on 30th July, 1853, at a salary of £300 per annum with apartments for himself and family in the museum. His resignation was announced 7th December, 1859, to take effect on 1st March, 1860. He is said to have gone back to England in 1861 but this is contradicted in Iredale's paper (1959), no alternative date being given; he may have gone to South Australia before leaving for England in 1863. Angas was never "Director .....of the Government Museum" (Anonymous, 1887): the term "Director" was rarely used in the early days of the Australian

Museum — Curator, Secretary, Superintendent or Zoologist were titles usually employed — a man could be a member of the committee of superintendence, curator and secretary all at once; there was not the clear definition of trustees, director, scientific, administrative and other staff, as we know them now. The office of paid Secretary of the Australian Museum was abolished by the Government in 1845 due to financial stringency, the Rev. W. B. Clarke having been the holder of the position at the time. Members of the Committee of Superintendence such as Lieut. Robert Lynd, R.N. (1845 to 1847) and the Rev. George E. Turner (1847 to 1853) acted as Honorary Secretaries, in the years indicated, just before Angas.

Malacologists may only be concerned with the works of Angas on molluscs. He was interested in collecting shells from childhood and made probably the first Australian shell collection. Very few shells, however, are featured in his early published productions (e.g. *New Zealanders*, 1847). George Bennett (1860, *Gatherings of a Naturalist in Australasia*, page vi) acknowledged, " The drawings, with a few exceptions, are from the accurate pencil of Mr. G. F. Angas...... ", so the Sea Lizard, *Glaucus hexapterygius* (Bennett, loc. cit., fig. 3) and the artifacts associated with Nautili (figs. 24-26) may be considered as amongst Angas's earliest published drawings of malacological subjects.

Iredale (1959: 363) observed that, " Angas did not illustrate his conchological papers except the one dealing with the Naked Marine Slugs. However when Cox prepared his *Monograph of Australian Land Shells* he asked Angas to examine some species in the British Museum, and Angas prepared coloured paintings which Cox included in two additional plates...... " The originals of these paintings of nudibranchs and land shells are in the Australian Museum to this day. (Australian Museum Library 101/B. 12.)

A number of Angas' shells went to the British Museum, others to the Hancock Museum, Newcastle-on-Tyne (see Hedley, 1913). Angas had the distinction of collecting the chiton, *Choriplax grayi*, still only known from his type from Sydney Harbour in the 1860's. His travels are fairly well documented in the references given below, but we know little of his whereabouts in Queensland about 1858. Certainly he was in Moreton Bay, as we learn from his correspondence with Brazier, which now claims our attention.

Angas' letters to Brazier.

The Mitchell Library, Sydney, has three substantial volumes of " Brazier Papers MSS " (Nos. A. 7321-3) which contain correspondence between Angas and Brazier from 1867 onwards. Angas' notepaper in each case bears the address: 72, Portland Road, Notting Hill, London. Sometimes there is a crest looking, to my unheraldic eye, like a swan-necked bird with a horseshoe in its hooked beak

above the motto *Semper vigilans.* Sometimes mourning notepaper is used.

The first letter is dated July 6th, 1867:

"Mr. John Brazier.

Dear Sir,

I was happy to receive your obliging letter of May 1st, and shall be glad to correspond with you, and to receive from you from time to time such shells as I may desire for description or otherwise. Of course I understand that I am to pay you for what I receive...... I send you by this mail (book post) a copy of my last paper on new Port Jackson shells (with plate) also the *1st part* of my list of Port Jackson & c. species — the second part I will send you when ready...... I am just now sending back to Sydney & to Dr. Cox, a large number of shells, *mostly* Port Jackson, which I have named for him at a vast amount of labour and research......

"......I will just put down a few names of *genera* which I want most......

"......Look on the red & yellow *gorgonias* near the Heads at *very low* tides, on them you will occasionally find specimens of *Ovulum*......

In haste, Yours faithfully

George French Angas."

In a letter dated Feb. 19th 1868, Angas asks Brazier about shells for purchase or exchange and looks forward to receiving a Volute which, if new, he will name after Brazier in the Proceedings of the Zoological Society. He tells Brazier the London prices for shells and adds a postscript, "I have lately been elected a Fellow of the Royal Geographical Society."

Angas' enthusiasm mounts as he writes on May 15, 1868:

"My dear Sir

I have received the *very interesting* box of shells ...... I find some that are *new*...... You are a most careful and correct naturalist...... Mr. Henry Adams is now examining all the very small species put up in *quills*...... What a famous place *Lake Macquarie* would be to *dredge* in...... By the bye, try dredging at *night* — then the carnivorous shells come out of their nestling places under rocks in deep water, to crawl about on the sands and *feed.* Very early at daybreak & at twilight till quite dark are the best times for dredging...... Try also sinking lobster pots or baskets......pull up after 2 nights & find your shells.

Yours very truly

Geo. F. Angas."

Memo., dated June 14th, 1868, acknowledging shells......" I think the Volute is *V. thatcheri* McCoy."

Letter dated June 19th, 1868, [acknowledges Brazier's letter, list and shells. The Volute which he had hoped to name after Brazier proved to be *thatcheri.* Angas is sending shells to Sydney by his friend Madame Fesq]. "*Voluta marmorata* is a shell I greatly desire......" [There is a list of Angas's identifications for Brazier.]

A list of identifications is also appended to another letter, of Sept. 30th, 1868, acknowledging another box of shells, some new, which he is going to describe and figure. Angas states, "......There is not a single copy to be had of my Monograph of the Port Jackson naked-gilled Mollusca......in the French Journal de Conchyliologie 5 or 6 years ago......"

A letter of Dec. 3rd, 1868, acknowledges box number 3. Angas is going to return the *Voluta punctata* Swainson compared with the specimen in the British Museum. He has the privilege of access to the Cuming collection on private days. A further list of identifications is supplied and on this Brazier had later penned localities, or remarks like "to be returned" or "given to Angas".

Angas says in a letter of Jan. 30th, 1869, that he is packing and forwarding shells to Brazier by Pickford's [though it seems he delayed this task for some time]. The *Voluta thatcheri*'s exact locality was Bampton Shoals. Angas comments on identities of various shells and writes, "How I wish New Guinea would open up a bit."

More remarks on various shells are in a letter of February 24th, 1869: "Dr. Cox has sent me a very remarkable discoidal helix...... I am going to describe it as *H. boydi* (after poor Ben Boyd). It is from Bougainville I."

[The name *Helix boydi* does not appear in Iredale's 1959 index, and Angas had second thoughts about naming the shell after the ill-fated adventurer, Boyd, who was killed by cannibals 18 years earlier at a time when Angas was on the goldfields. — G.P.W.]

"The *Helix macleayi* will bring joy to my heart......

"Many thanks for the photograph of the [Australian] Museum. It is quite an imposing building now......

"I do not want *Turbo imperialis* from Moreton Bay, thank you, as I have several I found there myself...... [This seems about the only definite reference to Angas's whereabouts in Queensland, probably in 1858 — G.P.W.]

"I quite agree with you about poor old Dr. Gray's madness. His *tri*nomial nomenclature of the Volutes is regarded by every body as absurd......

"I enclose my photo. with an earnest request that I may be favored with yours.

"Ever yours most truly

Geo. French Angas."

[How fitting it is, a century later, that this photograph which Angas sent to Brazier in Sydney should now be reproduced — G.P.W.]

The next letter in the series is from the same address, 72, Portland Road, Notting Hill, and is dated August 12th, 1869, but it comes from the conchologist's daughter, Annie A. Angas, explaining that, "After a long and very painful illness which has confined my dear Papa to his bed for many weeks which totally incapacited him from raising his hand to use a pen he appears now to be somewhat mending."

However, Angas is again capable of writing and acknowledging *Voluta elliotti* Sowerby from Brazier on Sept. 12th, 1869: "....I am sadly in arrears with my work and correspondence.... Many thanks for your photo."

Angas gives more notes on identifications in a letter of Oct. 7th, 1869, and reiterates his intention to keep types of new species to be placed eventually in the British Museum collection. [He was evidently a very conscientious worker who took great trouble to identify material and would not describe novelties from imperfect specimens; he also insisted on the necessity to figure new species and provide correctly named species to his correspondents. His letters to Brazier are less formal than before:] "I much regret that [*sic*] Dr. Cox having named an insignificant little snail after you. I am prevented giving your name to a good showy *snorter* of a helix."

"Our conchologists will have it that *Voluta ruckeri* is only a local *variety* of *piperita* and that both are nothing more than vars. of *rutila!* in fact that they originally sprang from the same fathers and mothers!! — I dont go quite so far myself...... "

Angas writes again on January 25th, 1870, saying that he is going to send shells to Brazier for him, Cox and Hargreaves. Angas was startled to see in "our Zoological Circular of the 13th" an entry which he cut out and pasted in the letter. It read as follows:

"7. — Dr. J. C. Cox. Descriptions of seventeen new species of Land-shells from the South Sea Islands, from the Cabinet of Mr. JOHN BRAZIER."

Angas was justifiably worried as to whether the new species he had so laboriously determined and described and figured might have been anticipated by Cox's paper. The latter was published in *Proc. Zool. Soc., London*, 1870 (1): 81-85.

On Feb. 18th, 1870, Angas says he has described and figured *Helix boydi* in his last paper [but this, according to Iredale (1959) was not published and we shall see why later. Angas also states that the top whorls of the specimens of *Voluta thatcheri* are gone so that really they are of no value whatever. He was evidently not aware of the deciduous nature of the protoconch.]

On May 18th, 1870, Angas is sorry Brazier sent Solomon Islands helices to Crosse at the same time as he sent them to Angas to describe as new. Two of Crosse's names will be synonyms of Angas's — "it is a pity that such 'collisions' should occur"...... "Curiously enough, Cox also had described......the same 2 helices that Crosse and I had but of course his descriptions were cancelled by Dr. Sclater, as my paper was already out......I *quite agree* with you about the New Caledonian Cypracas being merely *diseases.*"

Angas writes on November 21st, 1870:— "I have lately been busy at work on a *third* or supplementary list of the Port Jackson shells...... The Australian Volutes *generally* are quite a drug in the market. *V. norrissi,* formerly so rare sells for 3/- or 4/-. No French journals now! I suppose poor Crosse has put all his shells into a bomb proof cellar & is living on 2 ounces of horse a day. Is not this terrible war a disgrace to civilization?...... I send you my Photo. It looks very fierce!"

A similar chatty letter re volutes, etc. is dated April 15th, 1871.

Exchanges of shells are mentioned on December 21st, 1871, and: "Mr. H. Adams & myself (at Dr. Sclater's request) always correct both yours & Dr. Cox's papers for the press & take a good deal of trouble to see all is right...... I am sorry to say my *Helix boydi* was described by Gassies in French Journal previously under the name of *H. villandrei* & stated by him to come from New Caledonia!.........."

After some discussion of the names of *Helix* spp., on May 16th, 1872, Angas tells Brazier: "Only fancy *Voluta ruckeri, Voluta norrissi* (in fine order) are only worth 1/- each now in the market! They have come by the bushel. My friend Admiral Loring shewed me the other day a lovely live specimen of *Voluta harfordi* (Cox) which he dredged at Broad Sound in the H.M.S. "Iris" many years ago........ By the bye tell Hargreaves that I have just described a grand new Volute & named it after him. He shall have a copy of the plate & description."

The next letter is on crested notepaper, dated April 8th, 1874, and comes, like later letters, from a new address: 48, Norland Square, Notting Hill. It discusses shell exchanges.

On July 24, 1876, Angas offers to describe and figure shells from the "Chevert" expedition. "....I am confining myself principally to *snails*......I have made up my mind not to describe any shell unless I can give a colored figure with it......"

On October 10th, 1876: "The most curious and interesting little shell you sent me, dredged in 25 fathoms outside P. Jackson Heads is at first sight like a miniature *Voluta* but it forms a new *genus* for which I propose the new name of *Neovoluta*...... "

On March 3rd, 1877: 'I now make the grand total of species from N.S.W. 692!"

"I have altered the name of my new genus to *Microvoluta*....

"Pray do write me soon & accept many thanks from

Your obliged friend

George French Angas."

This friendly tone is abruptly dropped in Angas's next letter, of September 15th, 1878. [Only one specimen of *Laevicardium beechei* was obtained by the late Fred Strange on the eve of the massacre at the Percy Islands. He resents Brazier's imputation in the *Proceedings of the Linnean Society of New South Wales* that a second specimen was purloined from the Australian Museum at a time when Angas was on the staff thereof.]

On January 6th, 1879, Angas accepts Brazier's explanation and resumes the friendly correspondence: "Your favor of Nov. 6th. came duly to hand and I am truly glad to learn from it that *I* was *not* the person alluded to...... "

Angas travelled to various parts of the world to improve his health and on his return to London wrote from Norland Square on August 4th, 1884, thanking Brazier for proposing him as a Corresponding Member of the Linnean Society of New South Wales. "I am", he says, "already an *Honorary* Fellow of the Royal Society of South Australia, having been elected in 1879."

"I send you by this mail a copy of 'The Little Journal' containing a short sketch of my career........

"I will gladly join you in a joint paper on new genera & species........

"I sent as a present to the Australian Museum some 17 or so of Bird Skins I collected in Dominica. I made a fine collection of butterfles and moths in that island [in 1882 — G.P.W.] — 3 *new* butterflies & 2 *new* moths!"

A letter of June 5, 1886, is on mourning notepaper. Angas "has just lost my darling daughter......leaving a little motherless baby 5 days old, and a lovely boy of one year & 8 months." [Bereavement, illness and exceptionally cold weather have made Angas very ill but he hopes to recover and "go over all the lovely shells you have sent me, *most carefully*...... "]

From Norland Square, on June 22nd, 1886, he writes, "The specimens of *Helix strabo* Brazier pleased me very much...... " [Angas is still ill "and can take no solid food of any kind." The

weather continues very cold: " I see the temperature was *15° higher* in the *Arctic* Circle off North Cape of Norway than in London!!"]

This was Angas's last letter to Brazier since he died less than four months later.

In the Mitchell Library papers, one more letter is included, but it is evidently from some earlier year, from the old address, 72 Portland Road, Notting Hill, Nov. 4, but it is cut about and the year cannot be determined. — " I want to know if it was old Wall or the son, who was assistant taxidermist on board the " Curacoa " — I fancied the old man (formerly Curator of the Museum[)] was dead — please tell me *......

" I have got some men collecting for me in the Red Sea, at the lighthouses........ "

And so, in this second essay on " Conchologists of the Past ",† we salute George French Angas, pioneer artist-naturalist and modest adventurer. He had been to Greece and many parts of the Mediterranean and ascended Etna, he had " trod the forbidden threshold of Moslem palaces ", at St.Sophia, Stamboul, the Goldern Horn, visited the Bosphorus and isolated islands of the Atlantic and Pacific, climbed mountains in South America, been to St. Helena and Ascension, the Antarctic Ocean and round Cape Horn. On one occasion he marched barefooted forty miles in a day to arrive at Auckland and, earlier in New Zealand, under great dangers and difficulties, he had painted tabu objects and buildings of the Maoris. He had had his jaw broken by a Sydney tough at Woolloomooloo and, according to some manuscript by Gerald Krefft, had been knocked down by the then Director of the Australian Museum in a heated argument.

In Angas's own words *(The Kafirs Illustrated*, 1849, page B): " I felt that I was not born to sacrifice every high thought and feeling at the shrine of Mammon: I longed for the natural world; and with a glad and thrilling heart, I shook off, as it were, from my feet the dust of the city, and went forth alone to the uttermost ends of the earth."

Acknowledgements.

Thanks are expressed to the Director of the Australian Museum for sanction to reproduce Angas' portrait and to the Department of Photography and the Library of that institution for helpful services. The Mitchell Library and Public Library of New South Wales allowed me access to Angas' rare books, his letters

---

* It was the " old man," William Sheridan Wall — G.P.W.

† Conchologists of the Past. 1. Father Xavier Montrouzier (1820-1897). *J. Malac. Soc. Aust.*, 11: 59-61, pl. 9.

to Brazier, and his lithographed portraits. For helpful advice and discussion, I thank Mr. Tom Iredale and Dr. D. F. McMichael of Sydney and Mrs. J. E. Richardson of North Melbourne, Victoria.

REFERENCES

(A) Published biographies and notices.

ANGAS, George French, 1842. *A Ramble in Malta and Sicily* Smith Elder, London. 168 pp., pls. i-xiv & text-figs.

————, 1849. *The Kafirs Illustrated in a series of drawings......* J. Hogarth, London. 52 pp., portrait frontispiece, pls. i-xxx, text-figs. 1-11.

ANONYMOUS, [1845 or later]. — A Catalogue of Paintings by George French Angas, illustrative of the Natives and Scenery of New Zealand and South Australia; also Sketches in Brazil, Cape Verde Islands, New South Wales, &c. &c.
Price One Shilling.

————*, 1884. George French Angas, F.L.S. *The Little Journal* (London), 1 (3), May 1884: 230-234. [Typescript copy in Australian Museum, Sydney, no. P.23/47].

* Very probably by Angas himself as listed as "Autobiography" in W. W. Thorpe's MSS. compiled for Etheridge, 1919.

————, 1887. George French Angas. *Proc. Linn. Soc. Lond.* Session 1886-1887: 33-34.

AUSTRALIAN ENCYCLOPAEDIA, 1958. Vol. 1: 178-179.

AUSTRALIAN NATIONAL UNIVERSITY Department of History, 1963. *Biographical Register.* Short List: 5.

BENNETT, George, 1860. *Gatherings of a Naturalist in Australasia.* Van Voorst, London, pages vi, 205 & 245. (Most of the illustrations are by George French Angas.)

BURN, R., 1965. A centennial commentary and zoogeographical remarks on Angas' Sydney nudibranchs (Mollusca, Gastropoda). *J. Conch., Paris,* 104 (3): 85-93.

DANCE, S. P., 1966. *Shell Collecting, an illustrated history.* Faber & Faber, London. 344 pp., illustr. (G. F. Angas on pp. 211 & 278.)

DIXSON, [Sir] W., 1923. Notes on Australian Artists. Part vii. *J. R. Austr. Histor. Soc.,* 9:46-47.

ETHERIDGE, R., 1919. The Australian Museum: — Fragments of its early history. *Rec. Austr. Mus.* 12 (12): 367, 376, 382, 386 with fig. 16 (design by Angas), 387 & 389.

GORDON, M., 1940. The early artists of New Zealand: Angas the man who was just in time. *N. Zeal. Railways Mag.*, April, 1940: 20.

HEDLEY, C., 1909. Presidential Address. *Rept. Austr. Assoc. Adv. Sci.* (Brisbane): 336.

———, 1913. Studies on Australian Mollusca. Part XI. *Proc. Linn. Soc. N. S. Wales,* 38: 258-338, pls. 16-19.

HODDER, E., 1891. George Fife Angas. Hodder & Stoughton, London. pp. 199, 286 & 293.

ILLUSTRATED AUSTRALIAN ENCYCLOPAEDIA, 1925. Vol. 1: 58.

IREDALE, T., 1959. George French Angas: The Father of Australian Conchology. *Austr. Zool.* 12 (4): 362-371.

———, 1969. Charles Hedley. *Proc. R. Zool. Soc. N.S.W.*, 1967-68 (in press).

IREDALE, T. & HULL, A. F. BASSET, 1927. A Monograph of Australian Loricates. *Austr. Zool.* 4 (6): 339, pl. 47, top left fig. Also issued separately, 1927: 144, pl. 19, top left fig.

MENNELL, Philip, 1892. *Dictionary of Australasian Biography.* Hutchinson, London. p. 14.

MORGAN, [Sir] E. J. R., 1966. Angas, George French. *Aust. Dict. Biography*, 1, 1788-1850: 18-19.

MUSGRAVE, A., 1932. *Bibliography of Australian Entomology.* Royal Zoological Society, p. 5. Sydney.

REED, A. H. & A. W. REED, 1967. *Facsimile editions of the works of George French Angas* (prospectus, A. H. & A. W. Reed, Sydney, etc.): 1-16, portrait on cover. (And the facsimiles themselves.)

RUSKIN, Pamela, 1967. George French Angas, pioneer artist. *Walkabout* 33 (10), October 1967: 32-35, 4 figs. (including the 1848 portrait).

WHITLEY, G. P., 1968. Exhibition of photographs. *Abstr. Proc. Linn. Soc. N.S.W.* 756, p. 2.

WHITTELL, H. M., 1954. *The Literature of Australian Birds* Paterson Brokensha, Perth, W. Austr., p. 15.

(And other references, quoted in the above.)

(B) Manuscripts.

ANGAS, George French. Holograph correspondence with John Brazier. Mitchell Library, Sydney, Brazier Papers MSS. A 732/1-3.

———, Original paintings, in rare book cupboard, Australian Museum Library, 101/B. 12.

DIXSON, [Sir] William. Manuscript index, in Mitchell Library, to references to artists. (Angas' water-colours referred to in *Duncan's Weekly Register* 5, 1845: 46, the *Sydney Mail*, 4th June, 1913 and *Bell's Life in Sydney*, various dates between 1851 and 1853).

KOEHNE, [Miss] Monica, 1962. MSS.

KREFFT, Gerard, *circa* 1874. MSS.

MORGAN, [Sir] Edward, 1961. MSS.

THORPE, William W., *circa* 1915. MSS.

WHITLEY, Gilbert P., 1968. Manuscript History of the Australian Museum, chapter 5: 2, 22 + MS. re W. S. Wall, p. 4; chapter 6: 4, 7, 9; chapter 7: 4.

Mr. Tom Iredale possesses a bound volume of reprints of Angas' papers which belonged to John Brazier and in which Brazier had inserted numerous slips of paper bearing notes on Angas' species. In this volume there is also a proof plate with Angas' comments written thereon.

PLATE 3

George French Angas in about 1869. Original in Australian Museum, photographed by C. V. Turner.

DESCRIPTION OF A NEW SPECIES OF *PRONUCULA* (BIVALVIA, NUCULIDAE) FROM NEW SOUTH WALES AND ADDITIONAL NOTES ON SOME OTHER SPECIES OF THE SAME GENUS

By W. BERGMANS *

Text-fig. 1.

Among some lots of Nuculidae that were kindly lent to me by Mr. J. Voorwinde, Honorary Associate of the Australian Museum, Sydney, for study purposes, one specimen at once attracted my attention. It had already been labeled "*Nucula* sp. nov." by the owner and although it is often questionable whether it is justified to describe a new species from only one specimen the one concerned is so evidently different from all the known related species that have to be considered that I do not hesitate to confirm Mr. Voorwinde's remark with the following description.

In naming the novelty after Mr. Voorwinde I wish to express my admiration and appreciation of his indefatigable work in favour of the malacology of New South Wales, a work that on account of its mainly preparing character does not often come into publicity.

Pronucula voorwindei sp. nov.

Text fig. 1 a-c.

Description: Valve stout, convex, somewhat triangular in outline, slightly longer than high, less inequilateral than in other known *Pronucula* species of the same region. The embryonic shell is small, spherical and smooth. Its surface lacks the microscopical granular or pitlike structures that are present in other species. Beneath its surface irregularly placed tube-like features can be observed that give a similar impression. Compared to the embryonic shell surface structure in, for instance, *Pronucula hedleyi* (Pritchard & Gatliff) the subsuperficial structure in *voorwindei* is much coarser. From the relative smallness of the embryonic shell together with the habitus of the whole valve, its adultness — or almost adultness — might be concluded. (This conclusion is at least not contradicted by the fact that the umbo is not bifid and by the absence of a clear indication that is has been bifid, as is too the case in adult shells of *Pronucula* species that have bifid umbos when juvenile.) Only a small part of the umbonal region of the valve is without sculpture. The rest of the exterior is sculptured concentrically as

* Correspondence address: Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands.

well as radially. There are 14 strong, rounded, concentric ribs, about as broad as their interstices and covering the whole valve. They become weaker and sometimes run into each other on the anterior and posterior ends of the valve. Narrow but conspicuous radial riblets are visible only in the interstices of the concentrics. Their number increases towards the ventral margin, where I counted some 65 radials, and they do not extend on the anterior and posterior parts of the valve. The ventral margin is crenulated interiorly and exteriorly corresponding to the radial sculpture. The posterior region is slightly depressed and could be regarded as a real escutcheon. † The hinge line is arched, the chondrophore does not project beyond it. There are 6 teeth in the anterior and 5 in the posterior teeth row. The dorsal margins of the adductor scars are distinct, the pallial line is not visible. Exterior and interior of the valve are shining and coloured yellowish light brown.

Type material: Holotype, a single left valve, Australian Museum, Sydney, New South Wales, Australia, registered number C.67030. Dredged in 24 fathoms at Port Stephens, New South Wales, Australia.

Measurements: Length 1.80 mm, height 1.58 mm and section 0.58 mm.

Discussion: Of the known Australian *Pronucula* species, the very small *P. saltator* Iredale from Low Isles seems to be closest related, having a subtrigonal outline and a chondrophore that hardly projects beyond the hingeplate. In sculpture *P. cancellata* Cotton comes close, with strong concentric and weaker radial ribs. Radially unsculptured anterior and posterior shell parts are features that *P. voorwindei* has in common with *P. decorosa* Hedley, *P. cancellata* and *P. hedleyi*.

† In my former article on *Pronucula* (1968) 'anterior' and 'posterior' are confounded in all the descriptions except where Hedley is cited. Describing *Ennucula duritas* Iredale (1931), McMichael and Voorwinde made the same exchange (1966: 15).

By courtesy of the Director of the Australian Museum, Sydney, I was enabled to examine some samples of *Pronucula* from the Museum Collection. The following data can be added now to our knowledge of the distribution of some *Pronucula* species in New South Wales.

Pronucula cancellata Cotton

One valve, in bad condition, was dredged in 24 fathoms at Port Stephens.

Pronucula vincentiana Cotton & Godfrey

One juvenile specimen was taken from 6-8 fathoms, at Chinamans Beach, Middle Harbour, and one obsolete valve was found at North Head.

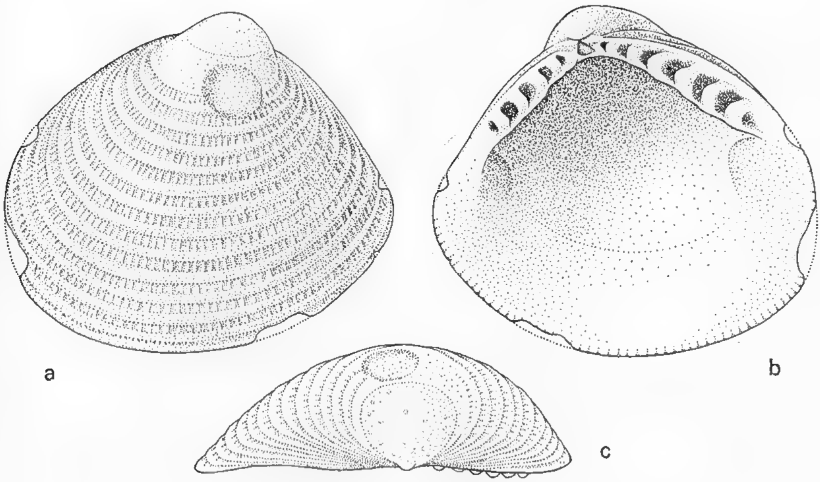


Fig. 1a-c. *Pronucula voorwindei* sp. nov., Holotype (drawings by the author).

Pronucula pusilla (Angas)

Four rather fresh, juvenile valves came from 2-4 fathoms, Fairlight, Port Jackson. One valve was dredged in 6-8 fathoms at Chinamans Beach, Middle Harbour.

Pronucula micans (Angas)

Two very obsolete valves were collected at North Head. One juvenile valve was dredged in 6-8 fathoms at Chinamans Beach, Middle Harbour.

Of *Pronucula decorosa* Hedley, I have seen specimens from localities in South Australia (dredged off Eucla; Collection Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands) and New South Wales (25-40 fathoms off Sydney; 40 fathoms off Laurieton; 25-40 fathoms off Nelson Bay; same collection). In adult specimens I counted from 35 to 40 radials near the margin. The epidermical pustules are arranged in rows that follow the radial ribs. The surface of the embryonic shells is microscopically pitted. The umbo in small specimens is bifid.

REFERENCES

BERGMANS, W. 1968. A survey of the species of the genus *Pronucula* in New South Wales. *J. Malac. Soc. Aust.*, 11: 71-78, pls. 11, 12.

IREDALE, T. 1939. *Scient. Rep. Gt Barrier Reef Exped.* Mollusca Part I: 209-425, pls. I-VII.

McMICHAEL, D. F. and J. VOORWINDE, 1966. Illustrations of unfigured New South Wales Marine Molluscs, Part I. *J. Malac. Soc. Aust.*, 10: 13-20, pls. 2-3.

A MEMORIAL REPORT ON THE TOM CRAWFORD COLLECTION OF VICTORIAN OPISTHOBRANCHIA

By

Robert Burn

Honorary Associate, National Museum of Victoria, Melbourne.

Plate 4, Text Figures 1-50.

SUMMARY

Thirty-nine species of opisthobranchiate Gastropoda from the central Victorian coastline comprise the collection of the late Tom Crawford (1944-1966). Six new species are described: *Aglaja henri Discodoris crawfordi, D. turia, D. paroa, Sclerodoris tarka* and *Acanthodoris nanega.* Zoogeographically, 71% of the remaining species form part of the large cool-temperate eurythermal fauna that extends from southern Queensland — northern New South Wales around southern Australia to south Western Australia, and 29% have circumglobal and Indo-Pacific relationships.

INTRODUCTION

Plate 4
Tom Crawford, 1966

Thomas William Crawford, only child of Margaret and Les Crawford of North Balwyn, Victoria, died in October 1966 at the early age of 22 years. In his crowded life from adolescence through youth to young manhood, his greatest interests lay in the natural sciences. At various times, he engaged in the fields of horticulture, botany, entomology, marine biology and malacology. From the time that he became a member of the Malacological Society of Australia in 1958 until shortly before his death, Tom collected extensively along the Victorian coastline and had amassed a large collection of molluscs, especially the smaller marine and terrestrial species. He was very interested in the 'Flinders Project', a detailed cumulative list and ecological survey of the molluscan fauna of the extensive reefs of Flinders,

organized by the Victorian Branch of the Malacological Society of Australia, and left manuscript notes of his research. He published one short article on the small molluscs associated with *Zostera* and *Posidonia* (Crawford, 1965). He dredged in depths up to 15 fathoms in Port Phillip Bay, Western Port and the inshore waters of Bass Strait, both by himself and in company. Many new records for the Victorian molluscan fauna are in his collection.

Obituary notices have appeared in the publications of the various societies of which he held membership: Royal Society of Victoria, *Proceedings* 80 (2): 345 (1967); Malacological Society of Australia, *Australian Newsletter* 15: 5 (1967); Marine Study Group of Victoria, *Marine News* 31: 1 (1967); and Australian Rhododendron Society, *The Rhododendron* 6 (1): 15 (1967). Tom Crawford was also a member of the Entomological Society of Victoria, and at an earlier age was an active member of the Junior Field Naturalists.

In December 1965, Tom Crawford gave the opisthobranchs of his collection, in all 39 species, together with field data and a few colour transparencies, to the writer for research purposes. The collection proved to be very valuable as it contained six new species. Consequently, the bulk of the collection has been retained as a whole and is here reported upon as a personal memorial to a brilliant collector and knowledgeable friend.

The writer acknowledges with sincere thanks the kindness of Mr. and Mrs. L. Crawford in loaning the photograph reproduced here. This research was carried out while the writer was in receipt of a grant from the Science and Industry Endowment Fund, C.S.I.R.O., Melbourne. The collection together with other material considered in this paper has been presented to the National Museum of Victoria, Melbourne. Unless otherwise stated, all material was collected by Tom Crawford; numbers preceded by the letter 'F' denote the registration number of the material in the National Museum of Victoria.

LIST OF SPECIES

Subclass *EUTHYNEURA*

Superorder OPISTHOBRANCHIA

Order *CEPHALASPIDEA*

Superfamily Bullacea

Family Atyidae

1. *Haminoea maugeansis* Burn, 1966. Fig. 1.
2. *Liloa brevis* (Quoy and Gaimard, 1832). Figs. 2-7.

Family Diaphanidae

3. *Diaphana tasmanica* (Beddome, 1883).

Superfamily Philinacea
Family Aglajidae
4. *Aglaja henri* sp. nov. Figs. 8-9.
Family Gastropteridae
5. *Gastropteron* sp.
Family Philinidae
6. *Philine columnaria* Hedley and May, 1908. Figs. 10-16.

Superfamily Runcinacea
Family Runcinidae
7. *Ilbia ilbi* Burn, 1963.

Order *ANASPIDEA*
Family Aplysiidae
8. *Aplysia (Pruvotaplysia) parvula* Morch, 1863.
9. *Aplysia (Varria) sowerbyi* Pilsbry, 1895.
10. *Aplysia (Aplysia) juliana* Quoy and Gaimard, 1832.

Order *ASCOGLOSSA*

Superfamily Juliacea
Family Bertheliniidae
11. *Tamanovalva babai* Burn, 1965.
12. *Edenttellina typica* Gatliff and Gabriel, 1911.

Superfamily Oxynoacea
Family Oxynoidae
13. *Oxynoe viridis* (Pease, 1861).
14. *Lophopleurella wilsoni* (Tate, 1889).

Order *NOTASPIDEA*

Superfamily Pleurobranchacea
Family Pleurobranchidae
15. *Berthella mediata* Burn, 1962.
16. *Pleurobranchaea maculata* (Quoy and Gaimard, 1832).

Order *DORIDACEA*

Suborder EUDORIDACEA

Tribe Cryptobranchia
Family Dorididae
Subfamily Chromodoridinae

17. *Chromodoris alternata* (Burn, 1957).
18. *Chromodoris perplexa* (Burn, 1957). Fig. 17
19. *Chromodoris* sp.

Subfamily Miamirinae

20. *Ceratosoma brevicaudatum* Abraham, 1876.

Subfamily Aldisinae

21. *Rostanga arbuta* (Angas, 1864).
22. *Rostanga hartleyi* Burn, 1958.

Subfamily Discodoridinae

23. *Discodoris dubia* Bergh, 1904. Fig. 18.
24. *Discodoris crawfordi* sp. nov. Figs. 19-24.
25. *Discodoris turia* sp. nov. Figs. 25-29.
26. *Discodoris paroa* sp. nov. Figs. 30-34.

Subfamily Halgerdinae

27. *Aphelodoris rossquicki* Burn, 1966.
28. *Sclerodoris tarka* sp. nov. Figs. 35-40.

Subfamily Platydoridinae

29. *Hoplodoris nodulosa* (Angas, 1864).

Tribe Phanerobranchia

Superfamily Nonsuctoria

Family Polyceridae

30. *Kaloplocamus ramosus* (Cantraine, 1835).

Superfamily Suctoria

Family Onchidorididae

31. *Acanthodoris nanega* sp. nov. Figs. 41-43.

Suborder POROSTOMATA

Family Dendrodorididae

32. *Dendrodoris nigra* (Stimpson, 1855).
33. *Doriopsilla staminea* (Basedow and Hedley, 1905). Figs. 44-45.
34. *Doriopsilla carneola* (Angas, 1864).

Order *DENDRONOTACEA*

Family Scyllaeidae

35. *Scyllaea pelagica* Linne, 1758.

Order *ARMINACEA*

Suborder PACHYGNATHA

Family Madrellidae

36. *Madrella sanguinea* (Angas, 1864).

Family Antiopellidae

37. *Caldukia affinis* (Burn, 1958).

Order *EOLIDACEA*

Suborder PLEUROPROCTA

Family Coryphellidae

38. *Coryphella poenicia* (Burn, 1957).

Suborder CLEIOPROCTA

Family Aeolidiidae

39. *Spurilla macleayi* (Angas, 1864). Figs. 46-50.

SYSTEMATIC SECTION

1. *Haminoea maugeansis* Burn, 1966

Figure 1.

Haminoea maugeansis Burn, 1966d: 330.

Material: Off Newhaven, Westernport, 6 fathoms on mud and *Zostera*, 11 May, 1963, 29 specimens, F26901.

Description: These specimens vary in dimensions from 4.4 by 3.1 mm. to 3.3 by 2.4 mm., therefore are slightly broader (74.5% - 72.7%) than the larger 7 by 5 mm. (71.4%) shells of the type series from Port MacDonnell, South Australia (Burn, 1966d: 330). Dark grey pigment cells remain along the mantle margin in preserved specimens and paler grey cells are present on the head shield and foot. As in other species, the inner dissolved whorls of the shell are marked only by a cord of tightly folded conchiolin. The original description omitted to mention that the Hancock's organs (Fig. 1) are both short and lowly ribbed. The radula has the formula 21 x 6.1.6, lateral teeth as originally described, the rhachidian differing by its smaller size and reduced cusp without lateral denticles. The ribs of the gastral plates are quite pointed in the middle line.

Remarks: H. maugeansis is close to the genus *Lamprohaminoea* Habe (1952: 150), the type of which *L. cymbalum* (Quoy and Gaimard, 1832) has recently been characterized (Marcus and Burch, 1965: 243). At present, the short ribbed Hancock's organs of the former prevent its assignment to *Lamprohaminoea* where these organs are long ridges.

2. *Liloa brevis* (Quoy and Gaimard, 1832)

Figures 2-7.

Bulla brevis Quoy and Gaimard, 1832: 358, pl. 26, fig. 36-37.

Haminoea brevis. Angas, 1867: 227; Pilsbry, 1894: 373, pl. 40, fig. 96, 9-10; Pritchard and Gatliff, 1903: 216; May, 1921: 104; 1923: pl. 46, fig. 16; Cotton and Godfrey, 1933: 85, pl. 1, fig. 14;

Macpherson and Gabriel, 1962: 242, fig. 282; Hodgkin et al., 1966: 53, pl. 21, fig. 6; Burn, 1966c: 266.

Haminoea cuticulifera Smith, 1872: 350; 1884: 87, pl. 6, fig. H; Angas, 1877: 189; Pilsbry, 1894: 372, pl. 41, fig. 13; Pritchard and Gatliff, 1903: 217; Cotton and Godfrey, 1933: 86.

Cylichna cuticulifera. Watson, 1886: 663.

Liloa brevis. Iredale and McMichael, 1962: 88.

Liloa cuticulifera. Allan, 1940: 178, figured; Iredale and McMichael, 1962: 88.

Haminoea (Liloa) cuticulifera. Allan, 1950: 200, fig. 45 (8).

Material: Off Newhaven, Westernport, 6 fathoms on mud and *Zostera,* 11 May, 1963, 50 specimens, F26902.

Off Safety Beach, Dromana, Port Phillip, 5 fathoms on muddy sand, 5 March, 1963, 2 specimens, F26903.

Off Rye pier, Port Phillip, 3 fathoms on *Zostera* beds, 5 March, 1963, 9 specimens, F26904.

Description: The shells (Fig. 2-3) measure from 12.8 by 6.4 mm., breadth 50%, to 2.9 by 1.8 mm., breadth 62.1%. They are thin, hyaline, with parallel sides as in Smith's figure (Pilsbry, 1894: pl. 41, fig. 13) and nearly square posterior end. The largest specimen has 19 stronger anterior and 10 weaker posterior thread-like striae, while 3 mm. long specimens have from 5 to 15 anterior and 3 to 6 posterior striae; some small specimens have 3 or 4 additional striae between the anterior and posterior lots. Port Phillip shells all have an orange periostracum, which is thicker at each end and along the inner side of the aperture.

The animal (Fig. 4) is creamy-yellow with small purple-brown spots ringed with aggregated white pigment cells in the mantle. The Hancock's organs are chrome yellow in life. The extended animal is twice the shell length. The head shield is small and bilobed behind; small black eyes show dorsally. A pair of triangulate parapodia covers the long neck, the ridge-like Hancock's organs (Fig. 5) and the anterior shell; their posterior end is level with the truncate tail of the foot.

The jaws are small, colourless or pale yellowish, crescentic in shape and made up of fine elements. The small radula has 17 x 22.1.22 teeth. The rhachidian (Fig. 6) is broad with a long cusp and a stout shorter denticle each side. The simple lateral teeth have a long cusp and broad base. The dark brown gastral plates have 17 arched ribs upon the edge of which stand short stout bristles of irregular height.

The male copulatory organ (Fig. 7) extends to the left over the alimentary tract, then curves to the right so that the prostate gland lies just below the skin on the right-hand side of the neck just within the shell. In an 8 mm. long shell, the male

organ measured 3 mm. in length; that from a 16 mm. long shell from Sydney Harbour measured 9 mm. in length, of which the prostate gland was 3.5 mm. long by 2 mm. wide. The penial papilla (p) is a long free appendage with dilated spherical head and narrower stem attached to the wall of the atrium at about the inner third. The penial stem is armed with numerous very small annular ribs from which minute spines project. The penial head is quite smooth except for a large conical hole in the outer face; this opens into a spherical flask-like sac, possibly for holding sperm, about one-third the diameter of the head, with muscular walls and spongy contents. A shallow depression in the annular ribs apparently conveys sperm along the stem to the penial head, if not to the sperical sac. The fundus of the atrium is blocked by a large spherical valve, within which project about 12 evenly spaced rather wide and high longitudinal plicae. The low ciliated rib extension of the seminal duct does not attain the outer opening of this valve. From the inner opening of the valve, the lumen passes each way into a pair of connected seminal vesicles. The upper pyriform vesicle (sv) is soft and flattened, its walls lined with about 20 concentric lamelliform plicae all centred upon the opening of the prostate gland. The longer lower banana-shaped vesicle is muscular and rounded in section; a single high rib projects into the lumen on the curved outer side. This rib continues to and rims the opening of the prostate gland in the upper vesicle. The ovoid prostate gland (pr) comprises small orange cells arranged in radials at the duct, and large yellow cells in four and five sided blocks away from it.

Remarks: As presently conceived, *Liloa brevis* is a variable species. Topotypical animals with shells matching the original description and figures need to be examined in order to justify the synonymy assembled above. The present material belongs to *L. brevis* as understood by past authors (Pritchard and Gatliff, 1903; May, 1921. 1923; Cotton and Godfrey, 1933), yet both conchologically and anatomically, it is identifiable with examined specimens of *L. cuticulifera* (Smith, 1872) from Sydney Harbour, New South Wales. Under these circumstances, the latter must become a synonym of the earlier *L. brevis.* On the other hand, local shells and a figured specimen from Western Australia (Hodgkin et al., 1966; pl. 21, fig. 6) differ from the type figures in the nearly square posterior end and the more oblong shape, but until it can be shown that these are valid differences justifying separation, it is preferable to identify the specimens with *L. brevis.*

The anatomy of *Liloa* appears not to have been described in the literature. Besides the cylindrical form of the shell and the presence of spiral striae, the present species at least is characterized by (i) animal twice length of shell, (ii) neck and anterior shell protected by strong, short parapodia, (iii) small crescentic jaws, (iv) non-denticulate *Haminoea*-like radula, formula 17 x

22.1.22, (v) gastral plates with short bristles along the ribs, and (vi) male copulatory organ with armed penis, ovoid prostate and paired seminal vesicles.

3. *Diaphana tasmanica* (Beddome, 1883)

Akera tasmanica Beddome, 1883: 169; Pilsbry, 1895: 379; Tate and May, 1901: 417, 460; Gatliff and Gabriel, 1908: 385, pl. 21, figs. 7-7b; May, 1921: 104; 1923: pl. 46, fig. 15; Cotton and Godfrey, 1933: 83; Crawford, 1965: 13.

Material: Ocean Beach, Flinders, on *Posidonia*, April-May, 1965, 6 plus specimens.

Remarks: This 2 mm. long species is common on *Posidonia* at the above locality where it may be collected by sweeping a fine sieve through the weed. The animal is not at all like *Akera*, being without parapodia and completely retractile within the shell. The body whorl is not separated by a sinus as suggested by Gatliff and Gabriel's figures, but is correctly described as "separated by a channelled suture" (Tate and May, 1901: 460). The shell, absence of parapodia and a brief observation of the radula (formula 1.1.1, teeth agreeing in shape with Odhner's figures, 1926: figs. 2-3) are sufficient to warrant the transfer of this species to *Diaphana*.

4. *Aglaja henri* sp. nov.

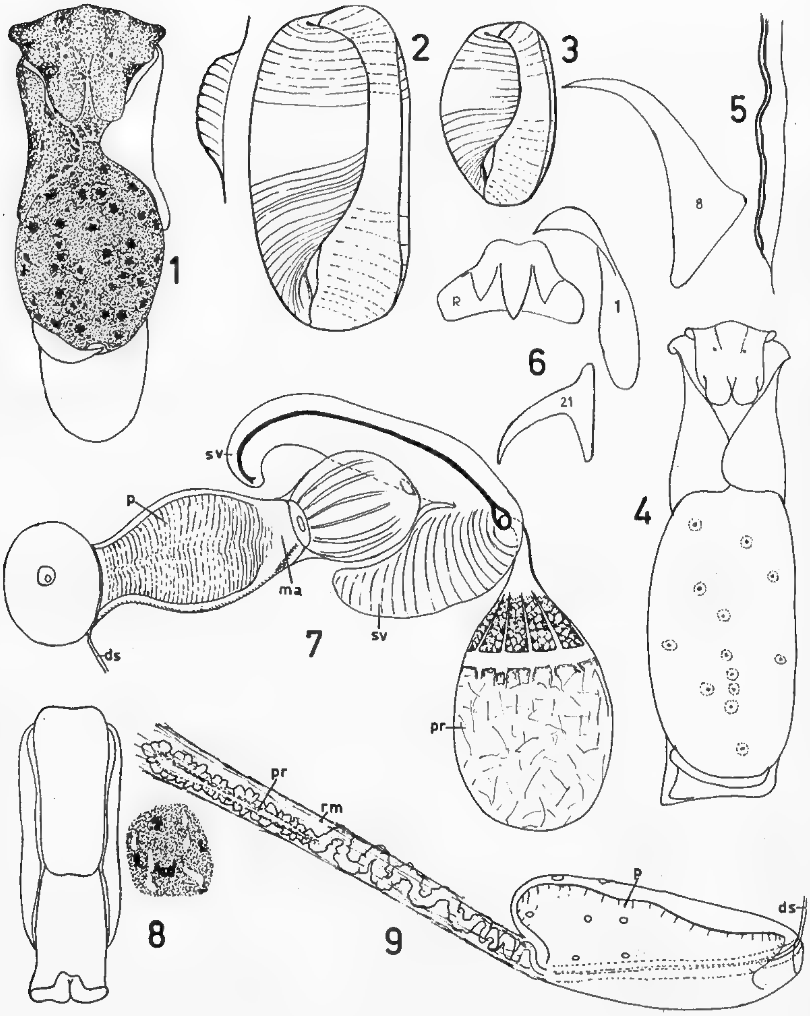
Figures 8-9.

Material: Point Henry, Corio Bay, Port Phillip, crawling among *Zostera* and *Caulerpa*, 24 April, 1966, 1 specimen (Holotype), Miss Margery Murray, F26905.

Yanakie Beach, Corner Inlet, crawling among *Zostera* at low tide, 23 April, 1965, 1 specimen, F26906.

Description: Alive, the Holotype (Fig. 8) was 28 mm. long and 10 mm. broad; preserved length is 22 mm. Animal dark brown, in detail composed of paler brown ground-colour, widely spaced very dark brown spots and flecks and translucent areas and patches, the latter filled with white spherical pigment cells. The latter predominate along the parapodial margins and rear of the head shield. The sole has only a few small dark brown spots.

The head shield is a little longer than the mantle shield, truncate at each end. The mantle shield has a pair of short posterior lobes of equal length. Short colourless setae were observed in life projecting from either side of the mouth. Fourteen deeply plicate dorsal plumes are present on the broad gill. The shell, approximately 4 mm. broad and 3 mm. long, is covered by a loose dark brown periostracum; a long tapering pillar-like columella projects on the inner side. The pharynx is large and very muscular. The male copulatory organ (Fig. 9) is of Marcus' type B, with a long simple coiled prostate (pr) coursing within the penial retractor muscle (rm) and the penial papilla (p) attached along one side



FIGURES 1-9. *Haminoea maugensis* Burn: 1, dorsal view of live animal and detail of Hancock's organ. *Liloa brevis* (Quoy and Gaimard): 2, largest Victorian shell; 3, smallest Victorian shell; 4, dorsal view of live animal; 5, Hancock's organ; 6, radular teeth; 7, male copulatory organ. *Aglaja henri* sp. no.: 8, dorsal view of live Holotype and detail of colour pattern; 9, male copulatory organ.

Key to lettering. a — ampulla, b — spermatheca, c — oral cavity, d — vas deferens, male or efferent duct, ds — seminal groove, g — vestibular gland, h — stylet, lp — labial palpes, ma — male atrium, penial sheath, n — nebensack, o — oral tentacles, oe — oesophagus, p — penis, pr — prostate gland, py — pharynx, rm — retractor muscle, s — spermatocyst, sv — seminal vesicle, v — vagina.

to the sheath except for the short free tip at the aperture and the rounded inner end. About 10 low conical warts project from the inner part of the sheath. The efferent duct within the penial papilla was not observed; probably the end towards the aperture is blind.

The Yanakie slug was 15-18 mm. long and of a rich purplish brown colour with numerous cream spots in life. Preserved, it is 8 mm. long and coloured dark brown with paler mottles on the head shield and parapodial and posterior margins. Its gill has 14 dorsal plumes. The penial papilla has an elongated tip near the aperture and a less distinct inner end, otherwise it is identical with the Holotype.

Remarks: Three other species of *Aglaja* are recorded from Victoria (Burn, 1966d: 267); they are each separated from *A. henri* in the following brief characterizations.

A. queritor Burn (1957b: 117): colour velvet black, 8 dorsal plumes on broad gill, male copulatory organ of Marcus' type A with free pillar-like penial papilla and short single prostate, pharynx large and strongly muscular.

A. taronga Allan (1933: 444; Burn, 1966a: 99): colour black or brown with orange submarginal spots and median pale stripe on head shield, 10 dorsal plumes on broad gill, male copulatory organ of Marcus' type D with poorly developed coiled penial papilla and very large lamella, pharynx large, and muscular.

A. cyanea (Martens, 1879; Burn, 1966c: 267): colour black with lighter mottles, stripes, spots or stipples; 16 dorsal plumes on long slender gill, male copulatory organ of Marcus' type A with small bilabiate (deeply cleft) penial papilla and long winding free prostate with irregular swellings along each side, pharynx absent, oesophagus wide and thin-walled.

Besides *A. henri*, *A. queritor* and *A. taronga* (Burn, 1966a: 100), *A. pusa* Marcus and Marcus (1967a: 18) and *A aureopunctata* (Rudman, 1968: 213) have sensory setae at each side of the mouth. This is a family character and is not diagnostic of *Chelid nura* as some authors believe.

Marcus' recognition of four distinctive types of male copulatory organ (1966: 164, fig. 28, A-D) contributes much towards the future subdivision of *Aglaja*. A brief analysis of both specimens and the literature shows that the species are also divisible according to the pharyngeal parts. The predators of polychaete and similar worms have a large muscular pharynx that fills almost the whole of the head shield. The predators and ingestors of other molluscs have a long soft non-muscular oesophagus. Thirdly, there are species with a short small muscular pharynx and a rather long soft oesophagus. These pharyngeal types occur indiscriminately among Marcus' copulatory organ types. The species of both *Cheli-*

donura and *Navanax,* synonymized by Bergh (1905: 42) but maintained without clear separation by Marcus and Marcus (1967b: 151) must be included in any overall revision of the Aglajid species.

The earliest designation of a type species of *Aglaja is* that of Suter (1913: 542) where *A. tricolorata* Renier was selected. This invalidates O' Donoghue's selection (1929: 10) of *A. depicta* Renier. Though the works of Renier have been rejected by the I.C.Z.N, (Opinion 427: 281-310, 1956), several taxa including *Aglaja* Renier (1807) have been set aside for further consideration.

5. *Gastropteron* sp.

Material: Merricks, Westernport, on tips of brown algae at night. 21st October, 1961, 5 specimens, F23061.

Specimens have also been collcted by the writer at Shoreham, Flinders, Point Lonsdale and Port Fairy.

Remarks: This bright red-orange species is similar in shape to the Japanese *G. flavum* Tokioka and Baba (1964: 212) and *G. fuscum* Baba and Tokioka (1965: 371) but differs in colour and radular details. It has a very distinctive male copulatory organ which unlike those already reported in the literature (Marcus, 1966: 163-164), has separate prostate gland and seminal vesicle. As in the Aglajidae, the male copulatory organ of the Gastropteridae can be a valuable specific character; in larger species it is rather similar, in smaller species peculiarly developed.

The description of this species is reserved for another paper.

6. *Philine columnaria* Hedley and May (1908)

Figures 10-16.

Philine columnaria Hedley and May, 1908: 123, pl. 24, fig. 25-26; Verco, 1909: 275; Gatliff and Gabriel, 1909: 43; May, 1921: 104; 1923: pl. 46, fig. 22; Iredale, 1924: 277; Cotton and Godfrey, 1933: 88.

Material: Off Griffith Point, between San Remo and Kilcunda, 10-15 fathoms, 30th May, 1965, 1 specimen, F26908.

Description: The shell had been removed and both it and the animal broken by the collector. Reconstructed length of body 13 mm. (head shield 7 mm., mantle shield 6 mm.), breadth at widest part of head shield 3.5 mm. The yellowish orange body (Fig. 10) is slender, rather pointed in front and rounded behind. Narrow parapodia are present only at the level of the posterior part of the head shield and do not cover the lateral furrow between the dorsal and ventral surfaces. Head with peculiarly developed lobes or oral tentacles (Fig. 11, o) each side of the mouth and between which there is an inner vertical pair of labial pillars or palpes (lp); anterior foot shallowly notched or sinuate below the mouth, tail truncate. The small rounded gill is thick, about seven lamellae stand each side.

The sculpture of the shell (Fig. 12) consists of close irregular striae about 0.1 mm. wide. At no place is it truely catenoid. The surface between the striae is minutely roughened.

Radular formula 21 x 1.0.1, teeth brownish, 0.4 mm. high and shaped as usual with about 35 denticles, larger in the middle part, on the inner edge (Fig. 13). The gastral plates (Fig. 14) are yellow, the paired plates 3.6 mm. long by 1.6 mm. wide, the unpaired plate 2.7 mm. by 1.3 mm. Each plate has a pair of oval foramina on the flat outer face.

The male copulatory organ (Fig. 15) lies beneath the alimentary canal and fills the whole ventral visceral cavity. The penial sheath (Fig. 16, ma) is filled by the hammer-shaped penial papilla (p) of which the arms exceed 1 mm. in overall length. The blind cylindrical arm lies within the aperture, the ejaculatory arm tapers and the tip lies in the 'nebensack' (Bergh, 1901: 284, pl. 24, fig. 2, d; 1905a: 32). The base of the penial papilla is spongy. The prostate gland (pr) is of uniform diameter, long but closely coiled and winding (covers area 4 by 2 mm.); the first narrower duct (d) is straighter and more muscular than the softer glomerate gland. The elongate pyriform seminal vesicle (sv) projects into the middle of the prostatic coils; its dilated end opens into the duct at its junction with the prostate gland.

Remarks: Even though the shell of the present specimen is broken into many pieces, it has been compared with Victorian shells from dredgings off Stoney Point, Western Port (Gatliff and Gabriel, 1909: 43) identified as *P. columnaria* by one of the original authors, W. L. May of Tasmania (Gabriel collection, identification dated 3rd November, 1908). The nature of the sculpture, in no place truly catenoid, and the shape of the posterior lip are decisive for this identification. Another shell in the Gabriel collection from 40 fathoms off Lakes Entrance (collected W. S. Ayres) is very similar to *P. columnaria* but has much finer catenoid sculpture and the posterior lip projecting farther above the apex. Gastral plates from the same specimen are black banded, relatively smaller and of equal shape and length. This specimen cannot be identified with any presently known Australian species.

The common southern Australian *P. angasi* (Crosse and Fischer, 1865; Burn, 1966c: 266) is a very much larger and broader species (largest Victorian specimen 74 mm. long and 40 mm. wide) with smooth shell. Anatomical characters to separate it from *P. columnaria* are a greater number (55) of less regular denticles on the 1.2 mm. high radular teeth which lack a basal flange, very large gastral plates (25 mm. long in a 36 mm. long specimen) deeply concave on the outer face and greatly attenuated at each end (Hedley, 1912: pl. 44, fig. 42-43), and in the male copulatory organ, the exceptionally long prostate gland, the very small penial papilla with hard disc-like head elongated on one side, and the absence

of a ‘nebensack’. These points also effectively distinguish *P. angasi* from *P. aperta* Linne (1758) where the shell is narrower posteriorly and the posterior lip lower, the gastral plates smaller in proportion to the animal length, 1/2.67 (Bergh, 1901: 281) compared with 1/1.44 in *P. angasi*, and the penial papilla has a pair of arms and the penial sheath a ‘nebensack’ (Bergh, 1901: 284, pl. 24, fig. 2-5).

The third Australian species in which the animal is known, *P. burrowsi* Burn (1961: 131) has a smooth shell like *P. angasi*, a narrow body like *P. columnaria* but with much wider parapodia than either species, and anteriorly truncate gastral plates. The penial papilla is unknown.

7. *Ilbia ilbi* Burn (1963)

Ilbia ilbi Burn, 1963: 15, figs. 12-20; 1966c: 268; Crawford, 1965: 13.

Material: Ocean Beach, Flinders, on *Posidonia*, May, 1965, numerous specimens.

Remarks: This purple and yellow species occurs in even greater numbers than *Diaphana tasmanica* on the *Posidonia* where it is taken by hand sieve.

Examination of several specimens indicates that gastral plates are absent, in contradiction to the original description (Burn, 1963: 18, fig. 18). The objects observed previously were pieces of the tough muscular walls of the large pharynx. Also, the glands previously referred to as the opaline glands (p. 18, figs. 14, 17) have proved to be portion of the ovatestis which had erupted through the notum during preservation.

Gastral plates are also absent in the New Zealand *Pseudoilbia* Miller and Rudman (1968: 188), but the latter has no rhachidian tooth in distinction from *Ilbia*.

8. *Aplysia (Pruvotaplysia) parvula* Morch (1863)

Reference: Eales, 1960: 287.

Material: San Remo, Westernport, 3 fathoms on weed under Phillip Island bridge, 6th April, 1963, 2 small specimens, F26909.

San Remo. Westernport, under rock near pier, May, 1964, 1 specimen, F27138.

Honeysuckle Point, Shoreham, Westernport, under stone at low tide, 29th December, 1962, 1 specimen, in B.M.(N.H.).

9. *Aplysia (Varria) sowerbyi* Pilsbry (1895)

Aplysia tigrina. Angas, 1867: 228; Sowerby, 1869: pl. 2, (non Rang, 1828).

Aplysia sowerbyi Pilsbry, 1895: 101; Allan, 1950: 213; Eales, 1960: 345, fig. 36.

Material: Whisky Bay, Wilsons Promentory, among conjevoi on very exposed rocks at low tide, 23rd April, 1965, 1 specimen, F26910.

Remarks: The single 30 mm. long slug is dull yellowish in colour. For the specific taxonomy, the following criteria have been considered as decisive. Brownish black reticulation drawn out near the parapodial edges into parallel vertical lines, absence of any distinctive pigment patterning on the inner parapodia. Mantle pointed anteriorly, shell with strongly oblique hard apex, parapodia separated posteriorly. The penis and opaline gland agreed with Eales' description (1960: 345) but not the radular formula or shape of the teeth. Obviously not fully developed, the radula has the formula 37 x 22.1.22. The rhachidian has far less prominent lateral denticles and lacks the anterior central knob. The large outer denticle of the first lateral is even more prominent but by the sixth lateral, both outer denticles are of equal length.

A. sowerbyi is recorded from Westernport (Eales, 1960: 390) and from Westernport and Portland (Macpherson and Gabriel, 1962: 248).

10. *Aplysia (Aplysia) juliana* Quoy and Gaimard (1832)

Reference: Eales, 1960: 363.

Material: Shallow Inlet, Wilsons Promontory, very common among *Zostera* at low tide, 24th April, 1965, 2 specimens, F26911.

Description: The two 40 mm. long strongly contracted slugs are very dark grey in colour with the following black patterning: longitudinal or transverse stripes on the head and neck, blotches and streaks of various sizes on the outer sides, a continuous wide band or irregular narrow strip on the inner parapodial margin and radials on the mantle. The shells are thick and clumsily formed; they have both horny and calcareous layers, easily separated in the present specimens. The radula has 37 rows with 24.1.24 teeth in the widest part. The rhachidian agrees closely with Eales' figure (1960: 367, fig. 46) but the cusp is more pronounced with somewhat stronger denticles away from the point. The laterals too have cusps twice as long as her figures indicate and the denticles again are stronger and larger. The penial sheath is as described (p. 366, fig. 45, a) with the exception that neither warts nor spines were found in the distal bulb around the base of the penial papilla. The latter is very long, flat and spatulate at the tip.

Remarks: These specimens are identified with *A. juliana* despite differences in the radular formula, teeth shape and penial sheath which may be attributed to their small size. Should larger and better preserved material be consistent then at least they could be separated subspecifically.

First records of *A. juliana* from Victoria were listed by Eales (1960: 386-387) where specimens were localized from Port Phillip and Portland.

11. *Tamanovalva babai* Burn (1965)

Berthelinia typica. Burn, 1960: 44; non *Edenttellina typica* Gatliff and Gabriel, 1911.

Edenttellina typica. Macpherson and Gabriel, 1962: 322, fig. 364; non Gatliff and Gabriel, 1911.

Tamanovalva babai Burn, 1965a: 735; 1966c: 268.

Material: Honeysuckle Point, Shoreham, Westernport, on *Caulerpa brownii* in a reef pool, 27th May, 1962, 1 specimen, F26914.

Remarks: Though the specimen has only 2 mm. shell length, the rather large erect protoconch is decisive for its identification. The other two bivalved gastropods of the Victorian coastline, *Edenttellina typica* Gatliff and Gabriel (1911) and *Midorigai australis* Burn (1960), have smaller protoconchs horizontally inclined, in the former above and in the latter below the umbonal level. The present specimen was bright green in life.

12. *Edenttellina typica* Gatliff and Gabriel (1911)

Edenttellina typica Gatliff and Gabriel, 1911: 190, pl. 46, figs. 5-6; Burn, 1965a: 735, figs. 1-2.

Material: Honeysuckle Point, Shoreham, Westernport, on *Caulerpa brownii* in a reef pool, 29th December, 1962, 2 specimens, F26915.

Point Lonsdale, Port Phillip Heads, on *Caulerpa brownii* in reef platform pool, 19th November, 1960, 13 specimens, F22703.

Remarks: Victorian marine biologists are indebted to the late Tom Crawford for the rediscovery of this species in 1960. Until then it was known only from single valves in shell sand. In life, the pale green animal is marked by 5 or 6 near-parallel broken lines of black pigment in each valve. The adult shell is very tumid and the protoconch far back from the anterior end. The length of the larger Shoreham specimen is 3 mm., of the largest Point Lonsdale specimen 3.4 mm.

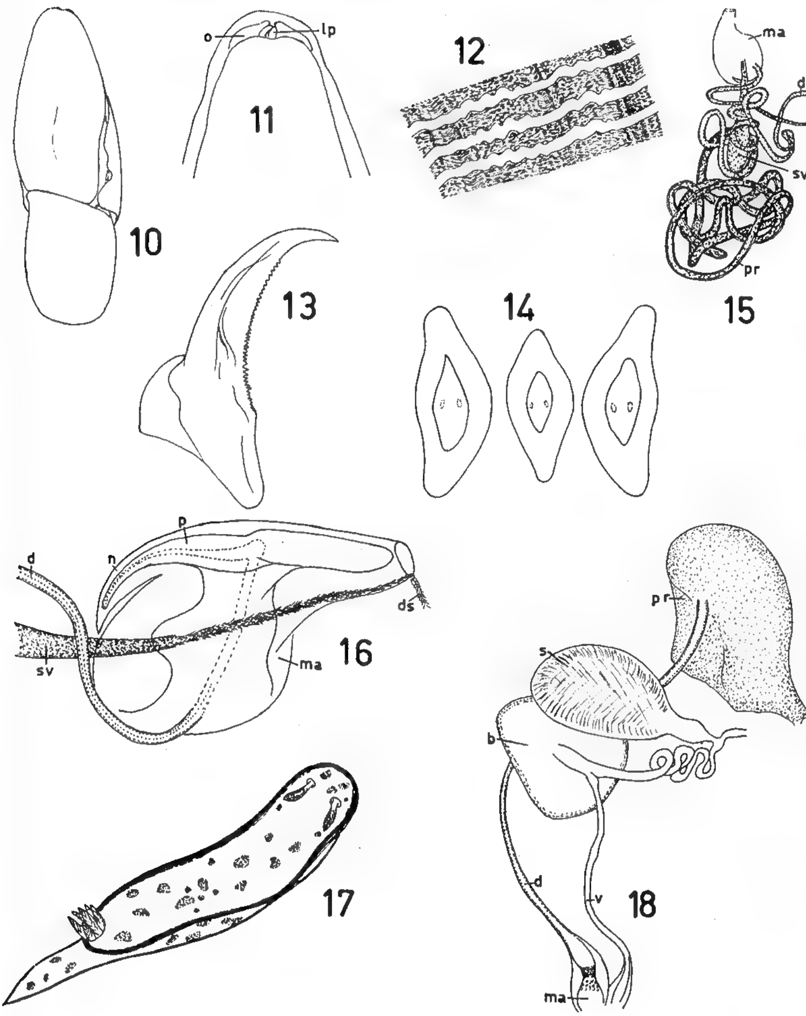
13. *Oxynoe viridis* (Pease)

Reference: Burn, 1966b: 55.

Material: Newhaven, Westernport, on green seaweed *(?Caulerpa)* on muddy bottom in 6 fathoms, 11th May, 1963, 1 specimen, F26912.

Remarks: This species has been reported from Victoria living on various species of *Caulerpa* (Burn, 1960: 46; 1966d, 269). It is not common in these cool temperate waters, nor as large as reported from the tropics. The present preserved specimen has a body length of 17 mm. and shell length 10 mm.

Since adding *Oxynoe hargravesi* H. Adams (1872) and *Akera aperta* Hedley (1899) to the synonymy of this species, (Burn, 1966b:



FIGURES 10-18. *Philine columnaria* Hedley and May: 10, dorsal view of reconstructed specimen; 11, ventral view of anterior body; 12, shell sculpture; 13, radular tooth; 14, gastral plates; 15, male copulatory organ; 16, penial papilla. *Chromodoris perplexa* (Burn): 17, dorsal view of live animal, from a painting by T. Crawford. *Discodoris dubia* Bergh: 18, male and female ducts of genital organs.

55), the writer has examined the Holotype of each species in the Australian Museum (April, 1968). Neither specimen showed any distinguishing characteristics to warrant separation from *O. viridis*. The probable earliest taxon for this species, *Lophocerus krohni* A. Adams (1854), needs to be justified by examination and illustration of the Holotype which should be in the collection of the British Museum (Natural History).

14. *Lophopleurella wilsoni* (Tate, 1889)

Lobiger wilsoni Tate, 1889: 66, pl. 11, fig. 12; Pilsbry, 1895: 168, frontispiece, fig. 5; Burn, 1966c: 270.

Lophopleurella wilsoni. Burn, 1966b: 58, fig. 26-30, 38.

Material: Ocean Beach, Flinders, on *Caulerpa brownii* in deep pool at outer edge of reef, 31st March, 1962, 1 specimen, F26913.

Remarks: The 3 mm. long specimen is typical of others collected by the writer at Torquay, Victoria (Burn, 1966b: 58). Small specimens are uniformly pale translucent green with darker viscera. Larger specimens have the slender parapodia tinted with blue at the base and third-quarter and tipped with orange. The rhinophores and mouth are also tipped with orange.

15. *Berthella mediata* Burn (1962)

Berthella mediatas Burn, 1962b: 142, pl. 2, figs. 7-8; 1966d: 271.

Material: San Remo, Westernport, under rock in muddy position, 23rd May, 1963, 3 specimens, F26916.

Other specimens collected at Shoreham, 27th May, 1962, and Flinders, 31st March, 1962, are now in the B.M.(N.H.).

16. *Pleurobranchaea maculata* (Quoy and Gaimard, 1832)

Reference: Burn, 1966a: 106.

Material: Flinders, under rock, 1st April, 1962, 2 specimens, in B.M.(N.H.).

17. *Chromodoris alternata* (Burn, 1957)

Glossodoris alternata Burn, 1957a: 17, pl. 1, figs. 10-11.

Chromodoris alternata Burn, 1966c: 272.

Material: San Remo, Westernport, very common under rocks, 23rd May, 1963, 7 specimens, F26917; under rock near pier, May, 1964, 1 specimen, F27139.

Remarks: The radular formula of large specimens is 50 x 30.1.30. The rhachidian is a minute cusp-less triangular thickening, the lateral teeth are as usual in this genus. Preserved slugs are always opaque with the large blue-black liver shining through the posterior notal and ventral surfaces.

18. *Chromodoris perplexa* (Burn, 1957)

Figure 17.

Glossodoris perplexa Burn, 1957a: 17, pl. 3, fig. 1.

Chromodoris perplexa Burn, 1966c: 272.

Material: Ocean Beach, Flinders, on weed in deep pool, 31st March, 1962, 1 specimen, F26918.

Description: "Living slug about 25 mm. in length. Body colour cream, notum edged with a mauve band and marked with 22 orange-yellow spots of irregular size and placement. Foot edge mauve, several large orange-yellow spots on the sides and a few more on the projecting tail. Rhinophores orange, cavities edged with mauve. Branchiae cream, tipped with orange" (T. Crawford).

Remarks: This description and a painting of the living slug (Fig. 17) confirm the identity of the greatly contracted colourless specimen. It is a rare species of which fewer than 10 specimens are known to the writer. These are from the type locality, Torquay, Point Lonsdale, and Flinders.

19. *Chromodoris sp.*

Material: Off Griffith Point, between San Remo and Kilcunda, on yellow sponge in 10-15 fathoms, 30th May, 1965, 1 specimen, F26919.

Description: The living slug was wholly canary yellow with brilliant orange spots round the notal edge and in the middle of the back. The rhinophores and branchiae were also canary yellow. The preserved specimen is bright pink and 6 mm. in length.

The body has a 2.6 mm. wide notum with pronounced overhang all round. The foot is 2 mm. wide. Seven lamellae can be seen on each rhinophore. Five pinnate branchiae lie within the branchial cavity.

The strong yellowish brown labial ring consists of short bifid elements set end on. The radula could not be found.

Remarks: The distinctive colouration of this specimen will allow for ready recognition when found again. Better material is required before this species can be given a specific name. None of the species of *Chromodoris,* or the closely allied *Hypselodoris* and *Noumea,* reported from Victoria are yellow nor do any of them become bright pink upon preservation. The bright yellow notaspidean, *Tylodina corticalis* (Tate, 1889), becomes dark pink or purple in alcohol; it too lives on yellow sponges.

20. *Ceratosoma brevicaudatum* Abraham, (1876)

References: Basedow and Hedley, 1905: 154; Burn, 1966d: 333.

Material: San Remo, Westernport, under and on rocks near pier, 23rd May, 1963, 5 species, F26580.

Stoney Point, Westernport, dredged on reef ½ mile from shore in 6 fathoms, 21st March, 1963, 1 specimen, F26581.

Ocean Beach, Flinders, on reef at low tide, 1st April, 1962, many specimens, in B.M.(N.H.).

Shoreham, Westernport, on weed in pools, 27th May, 1962, 3 specimens, in B.M.(N.H.).

21. *Rostanga arbuta* (Angas, 1864)

Doris arbutus Angas, 1864: 47, pl. 4, fig. 4.

Rostanga arbutus Allan, 1947: 445; 1950: 221; Burn, 1957a: 18; 1966c: 273.

Material: Ocean Beach, Flinders, under stone, 1st April, 1962, 1 specimen, in B.M.(N.H.).

Remarks: The jaws and radula of a 30 mm. live length specimen from Bancoora Reef, Breamlea, Victoria (leg. R. Burn, 13th June, 1955) were examined for comparison with the next species. The strong labium has two oblong areas of round-ended elements, finer and more numerous than in Japanese slugs (Baba, 1949: figs. 74 c). The radula has 60 rows of teeth of the formula 40.35.1.0.1.35.40, the shape of which agrees precisely with that of a New Zealand specimen (Eliot, 1907: pl. 28, fig. 3). The first lateral bears about 30 fine denticles on its inner side. The sequent 35 teeth are at first short in height and cusp-length, and increase in size away from the rhachis. The 40 comb-like marginals are not greatly curved and stand high above the inner teeth; the tips are split one to three times to form sort cusps.

Allan's assumption (1947: 445; Marcus, 1958: 25) that *R. arbuta* is the earliest name of this species appears to be correct. It is also identical with the New Zealand taxa *R. muscula* (Abraham, 1877) and *R. rubicunda* (Cheeseman, 1881), and as the senior synonym takes precedence. The fewer denticles on the first lateral tooth of *R. pulchra* MacFarland (1905: 40) from the eastern Pacific separate that species from *R. arbuta.* The other Australian species, *R. hartleyi* Burn (1958: 28) is pinkish grey in colour, the jaws are weaker, the radula smaller with a non-denticulate first lateral and unsplit marginals.

22. *Rostanga hartleyi* Burn (1958)

Rostanga hartleyi Burn, 1958: 28, pl. 2, fig. 12-13.

Jorunna hartleyi. Burn, 1962c: 163, figs. 15-16.

Material: Bear Gully, Waratah Bay, under stone at low tide, 1963, 1 specimen, F26907.

Description: "Mantle had peculiar granulated surface like (human) tongue. Colour generally pale mauvish with darker purply tops to papillae, making pattern of purple spots. Rhinophores fringed and pale in colour. Gills in a circle, about 10, finely branched, pale mauve. 25 mm. long." (T. Crawford.)

The preserved slug is 18 mm. long, pale mauve dorsally, more pink ventrally. The dense notal papillae are very slender and tall, with projecting spicules; their overall appearance is that of fine velvet pile. The rhinophores and branchiae have sheathed cavities; the latter are small and not greatly spread in life. Anterior foot bilabiate, the upper lamina very broad and deeply notched. The digitiform oral tentacles are long and smooth.

The present specimen and specimens from south-western Western Australia have small very weak jaws, elongate in shape and composed of fibrous rod-like elements; jaws were not observed in earlier descriptions (Burn, 1958; 1962c). Radula formula 21 x 23.0.23; first lateral slender and without cusp, six marginal needle-like and curved, remainder of laterals simply hamate.

A stylet is not present in the genital organs. The prostate gland is well developed, the eversible penial sheath is unarmed and the spherical seminal vesicles are serially combined.

Remarks: As there is no stylet attached to the genital complex, it is better to retain the present species in *Rostanga,* where it is very close to *R. evansi* Eliot (1905: 143) from the Cape Verd Islands. This latter species is light violet grey with white-edged darker spots on the notum, its jaws are weak and the radula is small, 18 x 20.0.20, with the first lateral tooth not differentiated from the sequental teeth and the taller marginals split several times. All other *Rostanga* species (Marcus, 1958: 24-25) have a red pigmentation and complex radular differences.

The distributions of *R. arbuta* and *R. hartleyi* overlap on the Victorian coastline. The former ranges from southern Queensland (Burn, 1966a: 106) through New South Wales and westward to Cape Otway, western Victoria (Burn, 1965b: 86). The latter ranges from south Western Australia (Burn, ms.) through South Australia to the western side of Wilsons Promontory, Victoria (present specimen).

23. *Discodoris dubia* Bergh (1904)

Figure 18.

Discodoris dubia Bergh, 1904: 50, pl. 3, figs. 29-30, pl. 4, figs. 1-6.

Discodoris egena Bergh, 1904: 54, pl. 4, figs. 7-14.

Alloiodoris marmorata. Basedow and Hedley, 1905: 152, pl. 8, figs. 1-2; Burn, 1957a: 19; non *A. marmorata* Bergh, 1904.

Alloiodoris nivosa Burn, 1958: 29, pl. 2, fig. 14; 1962c: 154; 1966c: 274.

Material: Merricks, Westernport, on algae in pool, 28th October, 1961, 1 specimen, in B.M.(N.H.).

Description: This is a variable species where specimens range in colour from pure white *(nivosa)* sometimes with a brown notal edge, to dark pinkish grey with brown rosettes on the notum

(marmorata of Basedow and Hedley), the latter always with dark brown spotting on the hyponotum, sides and sole. The notum is granular and firm in life, granular *(nivosa)* or smooth *(dubia, egena)* in preservative. The foot is bilabiate and notched in front, theoral tentacles are flat and digitiform. The dark grown rhinophores have about 20 lamellae and the 5 to 7 brown tinted branchiae are tripinnate.

The pharynx is very large. The labial cuticle may be smooth (Burn, 1958, 1962c), lightly armed with a fine three-sided armature *(dubia* var., Bergh, 1904: pl. 4, fig. 3), or heavily armed with a pair of distinctive jaws *(dubia, egena)*. All three conditions have been confirmed by examination of fresh material. The slender radula has from 33 to 48 rows of 17 - 23.0.17 - 23 simply hamate teeth.

The genital organs (Fig. 18) differ from the description and figure previously given (Burn, 1962c: 155, fig. 6). The very long male branch has a large white prostate gland (pr) closely attached to the gland mass, a long slender vas deferens (d) and a short penial sheath (ma). Minute wart-like papillae, not hooks as formerly reported, occur in a narrow band at the outer side of a darker sphincter-like swelling within the penial sheath. The female branch is narrower than the vas deferens, the hard orange spermatheca (b) and the soft white spermatocyst (s) are of equal size and semiserially connected.

Remarks: The chequered history of this species is understandable when the variability of the colour patterning and the buccal parts is known. The condition of the labium from smooth to strongly armed may be the result of differing methods of preservation; it is a matter for further study.

D. dubia may be distinguished from its Victorian congeners by the granular notum and the small number (17-23(of teeth in the radular half-row. It is also a far more common species generally found under stones in the more protected and deeper waters.

Absence of a lateral groove in the oral tentacles and the lower notal granulation appear to be the only differences separating *D. dubia* from *D. indecora* Bergh (1881: 108; Eliot, 1906a: 136; Pruvot-Fol, 1954: 270) of the Mediterranean and Cape Verd Islands. Similar colouration, small radulae and the hatchet shape of the jaws occur in both species.

24. *Discodoris crawfordi* sp. nov.

Figures 19-24.

Material: South Channel, Port Phillip Bay (2 miles NNW of McCrae lighthouse, near Hovell pile light), in cavity of large orange sponge dredged from 8 fathoms, sandy mud bottom, 5th March, 1963, 1 specimen, F26920 (Holotype).

Western Australia: Cottesloe, in a sponge, June, 1923, 2 specimens, L. Glauret, W.A.M. 10406/7 (Paratypes).

Description: The Holotype (Fig. 19) was 30 mm. long and 20 mm. broad in life, preserved it is 21 by 14 mm. Alive, the notum of the Holotype was apricot-orange with white tips to the papillae and a lighter yellowish notal margin; the sole and hyponotum were bright orange, the branchiae brownish orange, and the rhinophores brown with white apicial papilla and white edging to the lamellae at the anterior groove. The preserved Holotype is grey-orange notally, orange ventrally; the Cottesloe Paratypes are dull yellowish, the larger with some reddish-brown areas around the notal margin.

The body is broadly oval and rather plump. The notum is wholly covered by closely set 0.2 - 0.5 mm. high cylindrical papillae (Fig. 20) from the flat top of which 3 to 8 fine brown or hyaline spicules project. There are neither rhinophoral nor branchial sheaths. Rhinophores small with 8 or 9 oblique lamellae each side of a broad anterior groove, and a smooth apicial papilla. Branchiae 8 in number, bipinnate with wide stems, in life cup-shaped and not spreading. Head (Fig. 21) large with short truncate cylindrical oral tentacles. Foot anteriorly bilabiate and notched, tail broadly rounded and scarcely projecting beyond notum when extended.

The labial cuticle is very thin, the jaws (Fig. 22) rectangular, small, weak, composed of layers of closely packed slender rod-like elements. The formula of the broad radula of the Holotype is 57 x circa 64.0.64, of the smaller Cottesloe Paratype 50 x 50 - 60.0.50 - 60. The rhachis is wide, the innermost lateral (Fig. 23) small with wide basal plate and stout cusp. The succeeding laterals are higher with narrower basal plates. The marginal 10-16 teeth are curved and needle-like but not longer than the hamate laterals; they lie on the lateral teeth, but the distinction between hamate and needle-like is gradual, not abrupt.

The penis (Fig. 24) of the smaller Cottesloe Paratype is a short twice-folded tapering papilla densely armed with minute curved spines. It lies within a distinct flat circular atrium (ma) with a narrow aperture.

Remarks: At first (Burn, 1966c: 273), this species was identified as *Rostanga arbuta* (Angas, 1864). Both have similar notal papillation and at times colouration, but a denticulate first lateral tooth and split tips of the marginal teeth are not characters of *D. crawfordi.* Colour, notal granulation and the slender radula separate *D. dubia* Bergh (1904) from this new species.

According to collecting notes, several hours after capture the Holotype deposited a beautiful bright pink egg ribbon about 15 cm. in length and 5 mm. in height. The lower edge was thicker and smooth, the upper edge scalloped and undulate.

The species is dedicated to the late Tom Crawford, whose energies resulted in the discovery of the Holotype of this rarity, and who first directed the writer's attention to the fact that it was

possibly a new species. The habitat, in cavities of sponges, will probably assure that it remains uncommon even though the known localities indicate a wide southern Australian distribution.

25. *Discodoris turia* sp. nov.

Figures 25-29.

Material: Waratah Bay, in a large red sponge cast up on beach, 24th April, 1965, 1 specimen, F27121 (Holotype).

Description: The preserved slug (Fig. 25) is 9 mm. long and 6 mm. wide, and dull yellowish cream in colour. Alive it was cream with sandy speckles.

The body is broadly oval, wide anteriorly, rather soft and plump. The notum is covered with 0.2 mm. high cylindrical papillae (Fig. 26) but much less densely than in *D. crawfordi*. Spicules are prominent within the papillae but seldom project. The brown lamellate rhinophores are retracted as are the 8 bipinnate narrow-stemmed branchiae. Head (Fig. 27) with short conical oral tentacles, foot anteriorly bilabiate and notched, tail rounded behind.

The thin labium is armed with very small weak jaws (Fig. 28) made up of pale yellowish rod-like elements of irregular length and shape. The narrow radula (Fig. 29) has 39 rows of 40.0.40 teeth. The simply hamate first lateral is large with a long cusp that lies into the narrow rhachis. The succeeding laterals increase in size to about the twentieth tooth, after which the teeth are crowded, longer, very slender and strongly curved. They lie over the inner laterals.

Remarks: In many characters, it is difficult to separate *D. turia* from *D. crawfordi*, both of which occur in sponges. From the latter, *D. turia* differs in the cream not orange body colour, the less dense notal papillation, the slender radula with fewer rows and teeth, and in the slender strongly curved marginal teeth.

The specific name *turia* is derived from an Australian aboriginal word 'turi', the fighting boomerang, in allusion to the shape of the marginal radular teeth.

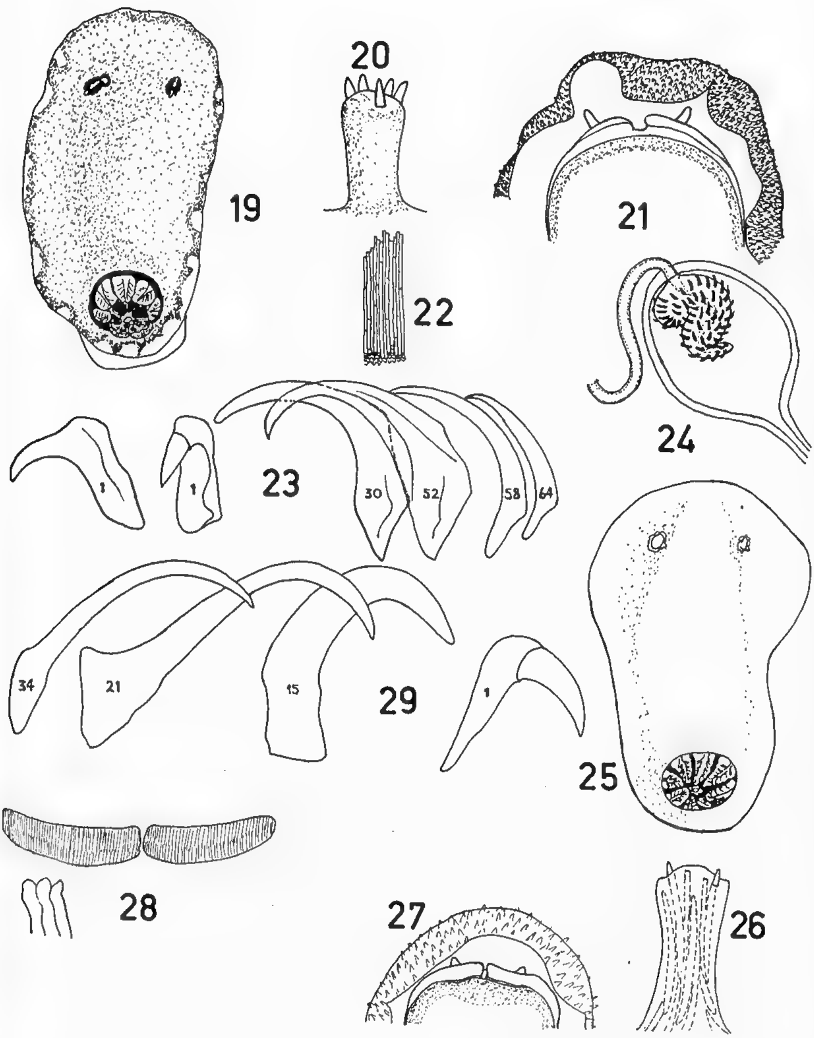
26. *Discodoris paroa* sp. nov.

Figures 30-34.

Material: Shoreham, Westernport, under stone, 27th May, 1962, 1 specimen, F27123 (Holotype).

Description: The extended Holotype measured nearly 25 mm. in life, as preserved 16 mm. long and 7 mm. wide. The live slug was bright red with dark brown spots, the branchiae were red and the rhinophores dark brown. Preserved, it is dull cream with dark brownish mottling all over the notum.

The body (Fig. 30) is oval, hard and plump. The notum is beset with low conical papillae (Fig. 31), the largest about 0.1



FIGURES 19-29. *Discodoris crawfordi* sp. nov.: 19, dorsal view of Holotype drawn from colour slide; 20, notal papilla; 21, ventral view of fore end; 22, jaw elements; 23, radular teeth; 24, penial papilla of Cottesloe Paratype. *Discordoris turia* sp. nov.: 25, dorsal view of preserved Holotype; 26, notal papilla; 27, ventral view of fore end; 28, jaws and elements; 29, radular teeth.

mm. high and as wide at the base, from which one to four colourless spicules project. The overall appearance of the notum is strongly granular. There are low rhinophoral sheaths but no branchial sheath. Rhinophores large, with at least 8 lamellae, the branchiae are probably 7 in number. Head small with short, proximally wider, flat oral tentacles (Fig. 32.) Anterior foot bilabiate and notched, tail rounded.

The labium is strong, the very weak horn-coloured jaws (Fig. 33) are composed of a small number of fibrous elements. Radula with 52 rows of circa 70.0.70 teeth. All teeth (Fig. 34) simply hamate, gradually increasing in height to 4-6 teeth from the margin. The marginals diminish rapidly but are not reduced or irregular.

Remarks: The brown spots on a red notum, weak jaws and uniformly hamate teeth are the special characters of *D. paroa.* It must not be confused with *D. crawfordi* which has orange colouration, cylindrical notal papillae, hexagonal labial elements, and long needle-like curved marginal teeth. *D. turia* has fewer teeth, cylindrical papillae and cream colouration.

The specific taxon *paroa* derives from the Australian aboriginal word 'paroo', a flat fish.

27. *Aphelodoris rossquicki* Burn (1966)

Aphelodoris rossquicki Burn, 1966d: 339, figs. 10-11, 31.

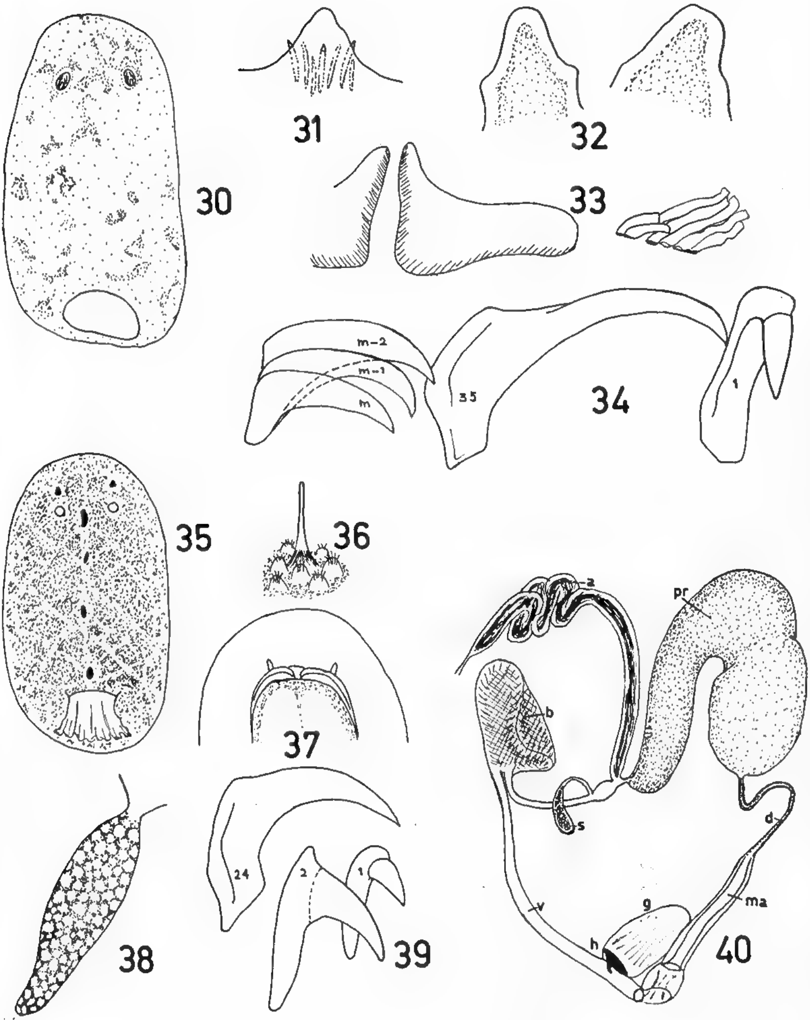
Material: Ocean Beach, Flinders, in pool, 31st March, 1962, 1 specimen, Miss Angela Hart and T. Crawford, F27128; under stone, 11th April, 1965, 1 specimen, F25659 (Holotype).

28. *Sclerodoris tarka* sp. nov.

Figures 35-40.

Material: Point Lonsdale, Port Phillip Heads, on coralline growths, 4th November, 1963, 1 specimen, R. Burn, F27125 (Paratype); on coralline growths, 24th October, 1964, 1 specimen, R. Burn, F27124 (Holotype); on algae, 21st December, 1964, R. Burn, F27126 (Paratype). San Remo, Westernport, ½ mile E of pier, 8 fathoms coral bottom, 11th May, 1963, 1 specimen, F27127 (Paratype).

Description: The largest specimen Paratype F27126 was 35 mm. long when extended, and at rest and as preserved measured 27 mm. long and 12 mm. wide. Colouration, which does not alter, varied from dusky yellow to yellowish orange, the notum further marked by (a) pale grey mottles between the cream fleshy reticulations, (b) in the Holotype a number of brown flecks and small spots, and (c) 3 to 7 brown pigmented pits along the indistinct median ridge. The hyponotum and foot are yellowish, in one specimen the very edges tinged pink. The rhinophores and branchiae are dull yellowish.



FIGURES 30-40. *Discodoris paroa* sp. nov.: 30, dorsal view of preserved Holotype; 31, notal papilla; 32, oral tentacles; 33, jaws and elements; 34, radular teeth. *Sclerodoris tarka* sp. nov.: 35, dorsal view of live specimen; 36, notal surface; 37, ventral view of fore end; 38, salivary gland; 39, radular teeth; 40, male and female ducts of genital organs.

The body (Fig. 35) is oval, rather flat, firm but not stiff. Low dome-like granules (Fig. 36) cover the notum except for a median series of 3 to 7 small to large pits. An indistinct median ridge and low fleshy reticulations pattern the notum. A single soft cylindrical high papilla without projecting spicules stands at each junction of the reticulations. Rhinophoral and branchial sheaths are low and granular. The rhinophores have 8 lamellae and apicial cylinder, the six tripinnate branchiae are not large. The head (Fig. 37) is not large, the oral tentacles short and digitiform. The very narrow foot is anteriorly bilabiate, the upper lamina notched and projecting as broad lappets.

Salivary glands (Fig. 38) long, fusiform but flat, glandular in appearance. Labium thin and smooth. Radular formula 35 x 45.0.45. The first tooth (Fig. 39) is slender with a short cusp, the second tooth is half as large again. Teeth 3 to 15 gradually increase in height and cusp length, teeth 16 to 42 are all nearly uniform, and the marginal three decrease sharply and are ill-formed. All teeth are simply hamate and non-denticulate.

In the genital organs (Fig. 40), the male branch consists of a large, soft, brownish bipartite prostate gland (pr), short slender muscular vas deferens (d) and dilated unarmed eversible penial sheath (ma). The female branch has a short broad vagina (v), large pyriform orange spermatheca (b) around which is folded the prostate, long slender uterine duct with separate opening to the spermatheca, and small narrowly pyriform spermatocyst (s) with a long duct. Projecting through the wall of the outer vagina nearest the penial sheath, there is a strong horny stylet (h) the base of which lies within its own ovoid vestibular gland (g). The hooked 0.3 mm. long stylet has a broader base, 0.4 mm. in diameter.

Remarks: Descriptions of the genus *Sclerodoris* are found only in the works of Eliot (1903: 361; 1906b: 1005; 1908: 114; 1910: 420). The generic characteristics pertinent to the new species are the notum marked with various ridges and depressions (the raised reticulate pattern), the narrow foot, the smooth labium and the unarmed genital organs. *S. tarka* differs from the five species listed by Eliot (1903: 355, 380-383) by the presence of the vaginal vestibular gland and horny stylet.

The specific name is derived from 'tark', an Australian aboriginal word for a light reed spear, in this instance the stylet of the vestibular gland.

29. *Hoplodoris nodulosa* (Angas, 1864)

Doris nodulosa Angas, 1864: 47, pl. 4, fig. 6; Burn, 1965b: 87.

Doris pustulata Abraham, 1877: 256, pl. 29, figs. 18-19; Burn, 1966c: 274.

Staurodoris pustulata. Burn, 1957a: 20.

Material: Honeysuckle Point, Shoreham, Westernport, under stone, 29th December, 1962, 3 specimens, F26575.

Remarks: In another manuscript, the writer has tabled the results of a study of some 30 specimens of this species and the full synonymy is listed with discussion. The salient points of *H. ncdulosa* are the tuberculose notum, notched anterior foot, strong labial armature, armed penial sheath, and most importantly, the distinctive stylet and associated gland beside the male duct.

30. *Kaloplocamus ramosus* (Cantraine, 1835)

References: Baba, 1949, 42, 136, pl. 14, figs. 48-49; Burn, 1958: 26.

Material: San Remo, Westernport, ½ mile E of pier, 8 fathoms on coral bottom, 11th May, 1963, 1 specimen, F27133.

Remarks: Previously from Torquay, Victoria (Burn, 1958) and beyond Australia from the Mediterranean, South and East Africa, and Japan (Macnae, 1958: 344).

31. *Acanthodoris nanega* sp. nov.

Figures 41- 43.

Material: Point Lonsdale, north side of rock platform, under stone among sand and algae, 31st December, 1966, 1 specimen, R. Burn, F27134 (Holotype).

San Remo, Westernport, under rock in muddy position near pier, 23rd May, 1963, 1 specimen, F27135 (Paratype).

Description: The living 3.5 mm. long Holotype (Fig. 41) was notally bright brick-red with yellowish tips to the rhinophores and branchiae, and ventrally paler pink with reddish maculations on the upper sides of the foot. Alive the Paratype was notally orange with brown-tipped papillae, dark brown rhinophores and translucent branchiae, and ventrally cream; it was 10 mm. in length. The preserved slugs are respectively 3 and 5.5 mm. long and in colour red and pale pink, each with brown-tipped notal papillae.

The body is broadly oval, a little wider in front than behind, firm and highly arched. In life, the notal papillae are conical with narrower bases; they are soft and capable of considerable variation in height and shape. The marginal papillae are smaller and closer spaced than those in the median area. Three larger and one small papillae stand at each rhinophoral cavity; these close completely over the retracted rhinophore. The latter are long, curved, with 12 oblique lamellae and an apicial cylindrical cap. The 7 (8) contactile bipinnate branchiae stand in a broad arch around the anus; notal papillae do not occur within the branchial arch.

The broad foot is bilabiate in front, rounded behind and projecting beyond the posterior notum when extended. The head is lunate or veliform and not distinguished in any way.

The jaws (Fig. 42) are small with pale yellowish elements as large as those in 25 mm. long specimens of *A. metulifera* Bergh

(Blackman's Bay, Tasmania, 16th October, 1958, leg. B. J. Neilson). The small crop is not at all prominent. There are 35 rows with one lateral and 5 marginal teeth per half row (Fig. 43). The lateral tooth has a wider base than that of *A. metulifera* and the cusp carries at most 2-3 denticles. The marginal teeth are short, rather deep and decrease outwards in size.

The genital organs have not been examined.

Remarks: From Australia, only one species of *Acanthodoris*, the Tasmanian *A. metulifera* Bergh (1905: 98) has been reported, and from New Zealand a further two or three species (Eliot, 1907: 329, 349-350). The recently collected specimens of *A. metulifera* noted above are larger than Bergh's single slug and except for a secondary small denticle below the cusp of the first marginal tooth agree exactly with his original description. The soft spike-like notal papillae of this species resemble *A. mollicella* Abraham (1877: 262, pl. 30, fig. 1) rather than the sparse low notal papillae of *A. globosa* Abraham (loc. cit., fig. 5), though it is with the latter that *A. metulifera* has been tentatively allied (Eliot, 1907: 329, 350; Marcus and Marcus, 1967b: 203).

A. nanega has sparse notal papillae similar to *A. globosa*, but the lateral tooth has a much broader base in the former to separate them. Unlike the new species, *A. metulifera* has notal papillae within the broad branchial arch. The more distantly related *Onchidoris maugeansis* (Burn, 1958: 26) from the same coastline as *A. nanega* is distinguished by its orange-yellow body, the small (4) number of rhinophoral leaves and the simply pinnate branchiae.

Nanega is adapted from the Australian aboriginal 'nannegai' or 'nannygai', a fish or more particularly a redfish, *Trachichthodes affinis*, a commonly trawled commercial species of south-eastern Australia.

32. *Dendrodoris nigra* (Stimpson, 1855)

Victorian references: Burn, 1957a: 22; 1966c: 275.

Material: Newhaven, Westernport, under stones beneath bridge, 6th April, 1963, 2 specimens, F27129.

Remarks: The present specimens of this common colour-variable Indo-Pacific species were 45 mm. long in life, rich dark brown in colour with a faint red line on the notal and foot margins. Their rhinophores were dark brown with a cream anterior rhachis between the 15 pairs of fine black lamellae, and the seven tripinnate branchiae were also dark brown.

33. *Doriopsilla staminea* (Basedow and Hedley, 1905)

Figures 44-45.

Archidoris staminea Basedow and Hedley, 1905: 151, pl. 6, figs. 3-4; Cotton and Godfrey, 1933: 101, pl. 1, figs. 4-5.

Dendrodoris staminea. Burn, 1957a: 22.

Doriopsilla staminea. Burn, 1962c: 167; 1966c: 276.

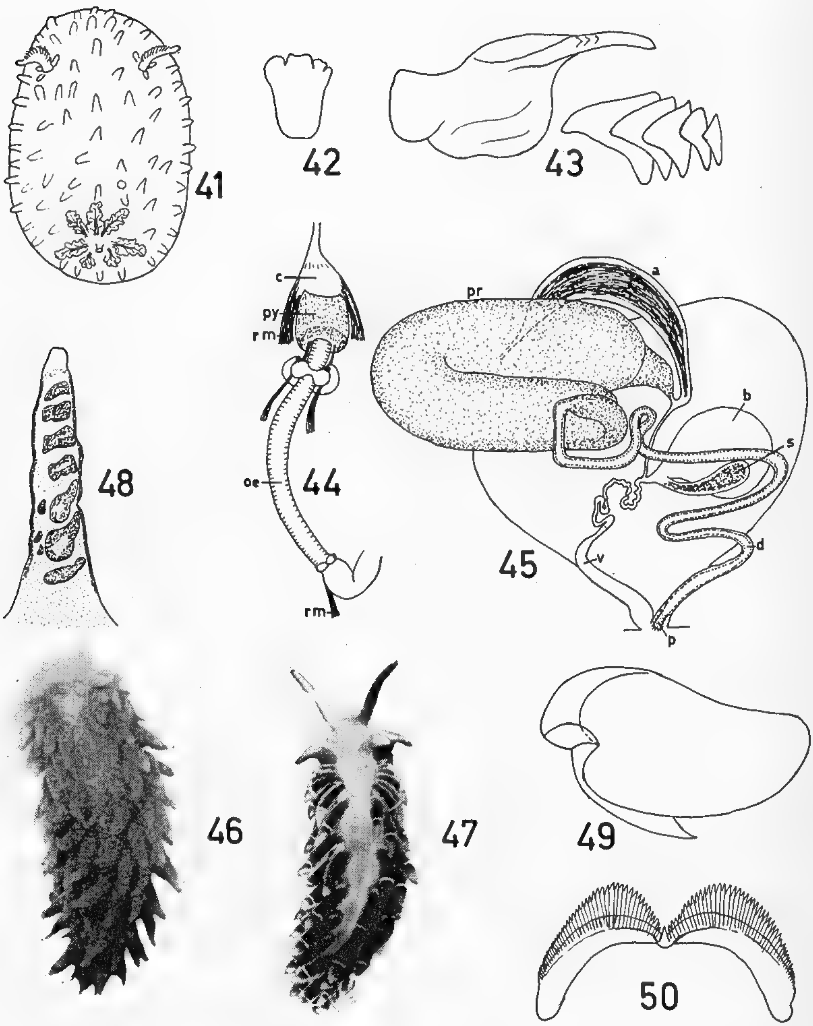
Material: Newhaven, Westernport, under stone beneath bridge, 6th April, 1963, 1 specimen, F27131.

Remarks: The preserved 11 mm. long cream specimen was in life 18 mm. long and bright yellow with scattered white spots in colour. The branchiae and rhinophores were orange-yellow. The notum is softer than *D. carneola* (Angas, 1864) and covered by low tubercles of varying diameter but uniform height.

For comparatative purposes, a 30 mm. long preserved specimen from Outer Harbour, South Australia was dissected. In both specimens the pharynx (Fig. 44, py) is pyriform, short and swollen with the oral cavity (c) folded over its anterior. The posterior of the pharynx is deeply impressed and the wide oesophagus (oe) issues from the middle of the impression. The oesophagus is shorter and wider than in either Australian species previously examined (Burn, 1966e: 350, figs. 23, 26). The nerve ring lies just behind the pharynx with the buccal ganglia immediately posterior to the pedal ganglia. The length of the combined pharynx and oesophagus is 4 mm. in the 11 mm. specimen, 9 mm. in the 30 mm. specimen.

The genital organs have the long winding vas deferens (Fig. 45, d) twice the diameter and half as long again as the vagina (v). The small pyriform spermatocyst (s) is embedded in the wall of the large ovoid spermatheca (b) which lies at the top of the vagina. The wider duct of the spermatocyst opens to the stem of the spermatheca; the slender uterine duct branches off somewhat lower down the stem. The large prostate gland (pr) is simple, the penial papilla (p) armed with minute hyaline hooks.

D. staminea is similar in colour only to *D. areolata* Bergh (1880; Marcus and Marcus, 1962: 472; 1966: 181), the type of the genus. The latter is distinguished by the smaller pharynx, longer oesophagus, shorter male and female ducts and the lobate prostate gland. Another yellow species, *D. miniata* (Alder and Hancock, 1864: 130; Eliot, 1906b: 665) occurs in eastern Australia under the name *Dendrodoris davisi* Allan (1933: 447; Burn, 1962c: 167). This has larger pustules of variable height, an epidermal spicule net that shows dorsally as generally transverse snow-white lines, a subepidermal spicule net which shows in the hyponotum as a regular large-squared pattern, and an orange to yellow body colour, darker over the viscera, with or without white notal markings. Its pharynx (in specimens from Iluka Bluff, northern New South Wales) is small and the oesophagus very long; the genital organs have a lobate prostate gland wrapped around the vesicles, short male and female ducts, ovoid spermatheca vaginal in position and small pyriform spermatocyst with long duct branching from vagina at same level as uterine duct.



FIGURES 41-50. *Acanthodoris nanega* sp. nov.: 41, dorsal view of live Holotype; 42, jaw element; 43, half row of radula. *Doriopsilla staminea* (Basedow and Hedley): 44, anterior alimentary tract; 45, genital organs. *Spurilla macleayi* (Angas): 46, live slug, Walkerville, Victoria, November, 1959, photo: J. Hope Black; 47, live slug, Long Reef, New South Wales, August, 1960, photo: A. Healy; 48 rhinophore of live slug from right-hand side, ribs heavy stippling, orange pigment light stippling; 49, jaw; 50. radular tooth. PLATE 4. Tom Crawford, 1966.

In all probability, *D. miniata* and *D. areolata* are identical, representing Indo-Pacific and Atlantic forms of a circumtropical species. Synonyms of *D. areolata* include *D. fedalae* Pruvot-Fol (1953: 92) from the eastern Atlantic and *D. janaina* Marcus and Marcus (1967a: 96) from the Pacific coast of the Canal Zone, Panama. An earlier Indo-Pacific synonym may be *Doris indurata* Stimpson (1855: 379) from China, which though meagrely described, obviously refers to a species like *D. miniata*.

34. *Doriopsilla carneola* (Angas, 1864)

References: Burn, 1962c: 169; 1965a: 87; 1966d: 350.

Material: San Remo, Westernport, under rocks near pier, 23rd May, 1963, 1 specimen, F27132; May, 1964, 2 specimens, F27130.

Remarks: The pharynx is Z-shaped with three straight sections and two folds, not thrice-folded as erroneously stated in the earlier description of South Australian specimens (Burn, 1966d).

It is quite probable that the *D. aurea* of Basedow and Hedley (1905: 157) and Burn (1966d: 350) is only a colour variation of *D. carneola*. The original *Doris aurea* Quoy and Gaimard (1832: 265) from Jervis Bay, New South Wales, has been transfered to *Dendrodoris* (Pruvot-Fol, 1934: 59); it has not yet been refound in Australian seas.

35. *Scyllaea pelagica* Linne (1758)

Reference: Burn, 1967: 116.

Material: Ocean Beach, Flinders, among brown algae in shallow reef pool, 9th May, 1965, 1 specimen, F26566.

Remarks: This record has already been published (loc. cit.). The first specimen to be reported from Victoria (Hedley, 1895: 199) is in the collections of the Australian Museum, Sydney, number C2124.

36. *Madrella sanguinea* (Angas, 1864)

Janus sanguineus Angas, 1864: 63, pl. 6, fig. 5.

Madrella sanguinea. Baba, 1937: 327, pl. 1, fig. 2; 1949: 82, 164, pl. 32, fig. 119 ; Burn, 1957a: 23; 1966c: 277.

Material: Point Lonsdale, under stone, June, 1964, 1 specimen, F27136.

Remarks: The distribution of this common blood-red species is south-eastern Australia, from the Clarence River Heads, northern New South Wales, to Port Fairy, western Victoria (Burn, 1965b: 89). It also occurs in Japan (Baba, 1937).

37. *Caldukia affinis* (Burn, 1958)

Proctonotus? affinis Burn, 1958: 32, pl. 2, fig. 15; 1966c: 278.

Caldukia affinis. Burn and Miller, 1969: 24.

Material: San Remo, Westernport, under stones near pier, May, 1964, 3 specimens, F27140.

Remarks: Most of the cerata have fallen off and the reddish pericardial patch is still present on these small but otherwise typical specimens. This is the type species of the genus *Caldukia* Burn and Miller described earlier in this number (1969: 23).

38. *Coryphella poenicia* (Burn, 1957)

Hervia poenicia Burn, 1957a: 25, pl. 2, figs. 7-10.

Coryphellina poenicia. Burn, 1962a: 107, figs. 9-10; 1966c: 279.

Material: Point Lonsdale, under stone, June, 1964, 1 specimen. F27137.

Remarks: As only posteriorly papillate rhinophores separate *Coryphellina* O'Donoghue (1929) from *Coryphella* Gray (1850) in which the rhinophores are described as smooth, irregularly rugulate and knotty (Odhner, 1939: 56), smooth, wrinkled, annulate and perfoliate (Marcus, 1961: 47; Marcus and Marcus, 1967b: 219, 221), there is no real justification for maintaining the former taxon (Dr. Michael Miller, *in litt.* 18th April, 1968).

C. poenicia has been observed among the very small tube-worm, *Spirorbis* sp. (Serpulidae), commonly found on the underside of stones at low tide level. Both the animal of this *Spirorbis* and the digestive glands of the slug are the same shade of red, hence the latter may feed upon the former.

39. *Spurilla macleayi* (Angas, 1864)

Figures 46-50.

Eolis macleayi Angas, 1864: 65, pl. 6, fig. 4.

Coryphella macleayi. Bergh, 1878: xvi; Basedow and Hedley, 1905: 135; Dakin, 1952: 270.

Aeolidiella macleayi. Burn, 1962a: 127; 1964: 399, right hand fig.; 1966c: 282.

Aeolidiella faustina. Burn, 1962a: 126; non Bergh, 1900, 1904.

Material: Bear Gully, Waratah Bay, crawling on *Galeolaria* tubes at low tide level, 1963, 1 specimen, F27141.

Description: "About 12 mm. long, body white, cerata and rhinophores pale brown sandy colour" (T. Crawford). Preserved, it is 8 mm. long. The largest living specimen examined, 34 mm. body length, 38 mm. including the outstretched tentacles, came from Balnarring, Westernport (leg. F. and M. Murray, 22nd March, 1964, preserved 7th July, 1964); its colour was pale grey with the dorsum, head and lower half of the rhinophores reddish, and the sole palest opaque pink. Yellow speckling was present all over the tentacles, head, dorsum and upper part of the cerata. Other Victorian specimens had the upper half of the tentacles and rhinophores lemon

yellow, two or three narrow bands of yellow on the cerata, and very rarely an orange-red suffusion on the anterior-dorsal surface of the cerata. A few specimens had the pericardium bright brick red. New South Wales specimens from the Sydney area had the white body with an orange or pink dorsal suffusion, dull brown digestive glands, and a white tip and a single, rarely two, yellow band at the third-quarter of the cerata.

The body (Figs. 46-47) is broad with cerata practically right to the tail tip. The wide thin edges of the foot do not project beyond the cerata; the anterior angles are produced into short strong tentaculiform processes which when the animal is crawling curve rearwards. The tentacles are short and tapered. The rhinophores (Fig. 48) are peculiarly ornamented in life with a slender posterior rib and 4-7 low oblique ribs each side; in preserved specimens with contracted rhinophores, the ribs appear as deep oblique lamellae. The cerata are fusiform.

The cerata in the largest specimen stand on five narrow arches and four oblique rows along each side; in a 9 mm. long specimen on four arches and four rows. They are generally inserted in a single series except in the first and second arches and the anterior limb of the third arch where they occur in double (alternating) series. The genital aperture lies below the space of the first arch on the right side. The anus opens high up in the second arch, the nephroproct lies closely in front but in the interhepatic space.

The yellowish jaws, 1.4 mm. long in the 8 mm. long preserved slug, are of the usual form (Fig. 49) with smooth masticatory borders. The not-greatly tapering radula has 17 broad teeth, at widest 0.3 mm., with two evenly rounded lobes separated by the emargination, in the centre of which stands a small tapering cusp. Up to 45 evenly graded tapering denticles stand on each lobe (Fig. 50).

Remarks: The generic diagnostic, rhinophores perfoliate (Bergh, 1864, 1877, 1890, 1892, 1905; Vayssiere, 1888; Thiele, 1931; Pruvot-Fol, 1954; Marcus, 1961) is no longer valid for *Spurilla* Bergh (1864). The various species here attributed to the genus have rhinophores that in life are perfoliate *(neapolitana, chromosoma)*, obliquely ribbed *(macleayi)* and bulbous *(japonica, alba)*. In preserved specimens, the rhinophores are invariably perfoliate by contraction; thus species based upon preserved specimens with this condition *(orientalis)* do not necessarily belong to *Spurilla*, the moreso if their liver branching is not known *(risbeci)*. Unquestionably, the most important characteristic of the genus is found in the liver branching and position of the anus; the latter is placed within the first arch of the posterior liver, and the right liver forms an arch *(neapolitana, macleayi)*, or three *(orientalis)*, four *(japonica, alba)* or five *(chromosoma)* rows of cerata in single or double series.

Minute denticles on the masticatory borders of the jaws have been reported in *neapolitana* (Bergh, 1877; pl. 12, fig. 6; 1883: pl. 1, figs. 12-13) and *orientalis* (Bergh, 1905: 224, pl. 19, fig. 29); recent writers report smooth borders in the former species (Pruvot-Fol, 1954: 433; Marcus and Marcus, 1967a: 118). The extension of the liver branching to the rhinophores and tentacle bases is peculiar to *Spurilla;* as well as in *neapolitana* (Vayssiere, 1888: pl. 5, fig. 79), it occurs in *japonica* (Baba, 1949: pl. 49, fig. 166a, b; Abe. 1964: pl. 36, fig. 128) and *alba* (visible in colour slide of specimen from Long Reef, New South Wales, 20th December, 1964, leg. A. Healy). The radular teeth are fairly uniform in all species, that is emarginate with a denticle in the median line and evenly graded denticles on each lobe. Only in *alba* is the median denticle longer than those flanking it. The emargination in *risbeci* (Risbec, 1956: pl. 21, fig. 112) is broad, in effect making the tooth concave in shape, thus different to all other species of the genus, but similar to some species of *Aeolidiella.* This species is therefore excluded from *Spurilla* and returned to its original genus as *Aeolidiella risbeci* (Marcus, 1961: 56).

Without reference to Engel's summary of the genus (1925), the species regarded as valid members of *Spurilla* are:

1. *S. neapolitana* (Delle Chiaje, 1823) — type species: Mediterranean, east and west Atlantic coasts, Caribbean.

2. *S. macleayi* (Angas, 1864: 65) — south-eastern Australia.

3. *S. orientalis* Bergh, (1905: 223) — Kei Islands, eastern Indonesia.

4. *S. chromosoma* (Cockerell and Eliot, 1905: 51) — California, Lower California, Gulf of California. *Aeolidiella olivae* MacFarland (1966: 373) is probably a synonym.

5. *S. japonica* (Eliot, 1913: 43) — Japan.

6. *S. alba* (Risbec, 1928: 261) — New Caledonia, eastern Australia. (Burn, 1966a: 107).

Neither of Bergh's descriptions of *Aeolidiella faustina* (1900: 235; 1904: 2) were available when *S. macleayi* was first discovered in Victoria (Burn, 1962a: 126), nor was the colour variation understood from the few specimens then examined. *A. faustina* has the anus behind the sixth or eighth row of cerata according to whether it came from New Zealand or Tasmania, hence cannot be identified with *S. macleayi.* Several species of *Aeolidiella* occur in south-eastern Australia, but neither their taxonomy nor anatomy has been investigated.

ZOOGEOGRAPHICAL REMARKS

The 39 species of Victorian opisthobranchs reported above include six new and two undetermined species which cannot form part of this discussion. The remaining 31 species are assessed in the following manner.

1. Nine species (29%) with relationships beyond Australia. One (3.2%) pelagic species, *Scyllaea pelagica*, and two (6.4%) sea-hares, *Aplysia parvula*, *A. juliana*, are circumglobal in tropical and temperate seas. One species (3.2%), *Kaloplocamus ramosus*, occurs in the Mediterranean, South and East Africa, and Japan. Two (6.4%) others are widely ranging throughout the Indo-Pacific, *Oxynoe viridis*, *Dendrodoris nigra*. A disjunct relationship with the Japanese fauna is evidenced in *Pleurobranchaea maculata*, *Rostanga arbuta* and *Madrella sanguinea* (9.8%), the former two species occurring also in New Zealand.

2. Twenty-two species (71%) indigenous to Australia. Four species (12.9%) together with *Discodoris crawfordi* sp. nov. range from central Victoria to southern Western Australia: *Liloa brevis*, *Ceratosoma brevicaudatum*, *Hoplodoris nodulosa*, *Rostanga hartleyi*. The first three extend further eastward to northern New South Wales.

   Thirteen species (41.9%) have, at present, a narrower distribution within the eastern part of the preceding wide area; the Gulfs of South Australia to central Victoria, *Haminoea maugeansis*, *Diaphana tasmanica*, *Tamanovalva babai*, *Berthella mediata*, *Chromodoris alternata*, *Discodoris dubia*, *Doriopsilla staminea;* the Gulfs of South Australia to central New South Wales, *Philine columnaria*, *Edenttellina typica*, *Doriopsilla carneola;* central Victoria to central New South Wales, *Spurilla macleayi*, *Caldukia affinis*, *Aplysia sowerbyi.*

   Five species (16.2%) are purely Victorian, being confined to the coastline between Wilsons Promontory in the east and Cape Otway in the west, *Ilbia ilbi*, *Lophopleurella wilsoni*, *Chromodoris perplexa*, *Aphelodoris rossquicki*, *Coryphella poenicia*. *Gastropteon* sp. also belongs to this group but extends 125 km. further westward to Port Fairy.

The indigenous species all belong to the large eurythermal temperate fauna of southern Australia, which so far as the opisthobranchs are concerned extends from southern Queensland - northern New South Wales to south Western Australia. Subfaunae appear to be present within this wide faunal area as evidenced by the above groupings of species. However, knowledge of the opisthobranchs must be far more advanced than at present before these subfauna can be delimited with safety.

REFERENCES

ABE, T., 1964. *Opisthobranchia of Toyama Bay and Adjacent Waters,* Hokuryu-Kan, Tokyo. ix + 99 pp., 36 pls.

ABRAHAM, P., 1877. Revision of the anthobranchiate nudibranchiate Mollusca. *Proc. Zool. Soc. Lond.,* 1877: 196-269, pl. 27-30.

ALDER, J. and A. HANCOCK, 1864. Notice on a collection of nudibranchiate Mollusca made in India, etc. *Trans. Zool. Soc. Lond.,* 5 (3): 113-148, pl. 28-33.

ALLAN, J., 1933. Opisthobranchs from Australia. *Rec. Aust. Mus.,* 18 (9): 443-450, pl. 56.

———, 1940. Australian shells: bubble and allied shells. *Aust. Mus. Mag.,* 7 (5): 174-178.

———, 1947. Nudibranchia from the Clarence River Heads, etc. *Rec. Aust. Mus.,* 21 (8): 433-463, pls. 41-43.

———, 1950. *Australian Shells.* Georgian House, Melbourne. xxi + 487 pp., 44 pls.

ANGAS, G., 1864. Descriptions d'especes nouvelles appartenant a plusiers genres de mollusques nudibranches . . . de Port Jackson, etc. *J. Conch., Paris,* 12: 43-70, pls. 4-6.

———, 1867. List of species of marine Mollusca found in Port Jackson Harbour, etc. I. *Proc. Zool. Soc. Lond.,* 1867: 185-233.

———, 1877. A further list of additional species of marine Mollusca to be included in the fauna of Port Jackson, etc. *Proc. Zool. Soc. Lond.,* 1877: 178-191.

BABA, K., 1937. Opisthobranchia of Japan (II). *J. Dep. Agric. Kyushu Univ.,* 5 (7): 289-344, pls. 1-2.

———, 1949. *Opisthobranchia of Sagami Bay.* Iwanami Shoten, Tokyo. 194 + 7 pp., 50 pls.

BABA, K. and T. TOKIOKA, 1965. Two more new species of *Gastropteron* from Japan, etc. *Publs Seto Mar. Biol. Lab.,* 12 (5): 363-378, pl. 25.

BASEDOW, H. and C. HEDLEY, 1905. South Australian nudibranchs, etc. *Trans. R. Soc. S. Aust.,* 29: 134-160, pls. 1-12.

BEDDOME, C., 1883. Descriptions of some new marine shells of Tasmania. *Proc. R. Soc. Tas.,* 1881 - 2: 167-170.

BERGH, R., 1864. Anatomiske Bidrag til kundskab om aeolidierne. *Danske Vidensk. Selsk. Skr.,* (5), 7: 1-175, pls. 1-9.

———, 1877. Beitrage zur Kenntniss der Aeolidiaden, IV. *Verh. Zool. Bot. Ges. Wien*, 26: 737-764, pls. 9-12.

———, 1878. *Malacologische Untersuchungen.* In: *Reisen im Archipel der Philippinen.* (By C. Semper.) 2 (14): 603-645, i-ii, pls. 66-68.

———, 1881. *Ibid.*, 4 (Suppl. 2): 79-128, pls. G-L.

———, 1883, Beitrage zur Kenntniss der Aeolidiaden, VII. *Verh. Zool. Bot. Ges. Wien*, 32: 7-74, pls. 1-6.

———, 1890. Die cladohepatischen Nudibranchien. *Zool. Jb. (Syst.)*, 5 (1): 1-75.

———, 1892. *Malacologische Untersuchungen.* 3 (18): 995-1165.

———, 1900. Ergebnisse einer Reise nach dem Pacific. *Zool Jb. (Syst.)*, 13: 207-246, pls. 19-21.

———, 1901. *Malacologische Untersuchungen.* 5 (3, 2): 257-312, pls. 21-24.

———, 1904. *Ibid.*, 6 (1): 1-56, pls. 1-4.

———, 1905a *Ibid.*, 6 (2): 57-116, pls. 5-8.

———, 1905b. Die Opisthobranchiata der Siboga Expedition. *Sib. Exp.*, part 50: 1-248, pls. 1-20.

BURN, R., 1957a. On some Opisthobranchia from Victoria. *J. Malac. Soc. Aust.*, 1: 11-29.

———, 1957b. A new species of Opisthobranchia from Victoria. *Vict. Nat.*, 74 (8): 115-117.

———, 1958. Further Victorian Opisthobranchia. *J. Malac. Soc. Aust.*, 2: 20-36.

———, 1960. Australian Bivalve Gastropods. *Nature*, 187 (no. 4731): 44-46.

———, 1961. Two new species and a new genus of opisthobranch molluscs from New South Wales. *Proc. R. Zool. Soc. N.S.W.*, 1958-9: 131-135.

———, 1962a. Descriptions of Victorian nudibranchiate Mollusca, etc. *Mem. Natn. Mus., Melb.*, 25: 95-128.

———, 1962b. On the new pleurobranch subfamily Berthellinae etc. *Ibid.*, 25: 129-148, pls. 1-2.

———, 1962c. Notes on a collection of Nudibranchia (Dorididae and Dendrodoridinae) from South Australia. *Ibid.*, 25: 149-172, pl. 1.

———, 1963. Australian Runcinacea. *Aust. Zool.*, 13 (1): 9-23.

———, 1964. Australian sea-slugs. *Aust. Nat. Hist.*, 14 (12): 396-399.

———, 1965a. Rediscovery and Taxonomy of *Edenttellina typica* Gatliff and Gabriel. *Nature*, 206 (no. 4985): 735-736.

———, 1965b. A centennial commentary and zoogeographical remarks on Angas' Sydney nudibranchs. *J. Conch., Paris*, 104: 85-93.

———, 1966a. Some opisthobranchs from southern Queensland. *J. Malac. Soc. Aust.*, 9: 96-109.

———, 1966b. The opisthobranchs of a Caulerpan microfauna from Fiji. *Proc. Malac. Soc. Lond.*, 37 (1): 45-65.

———, 1966c. Port Phillip Survey 1957-63. Opisthobranchia. *Mem. Natn. Mus. Melb.*, 27: 265-288.

———, 1966d. Notes on some opisthobranchs mainly from South Australia. *Rec. S. Aust. Mus.*, 15 (2): 329-352.

———, 1967. First record of a pelagic eolid from Victoria. *Vict. Nat.*, 84 (4): 116-117.

BURN, R. and M. MILLER, 1969. A new genus, *Caldukia*, and an extended description of the type species, *Proctonotus? affinis* Burn. *J. Malac. Soc. Aust.*, 12: 23-31.

COCKRELL, T. and C. ELIOT, 1905. Notes on a collection of California nudibranchs. *J. Malac.*, 12 (3): 31-53, pls. 7-8.

COTTON, B. and F. GODFREY, 1933. South Australian Shells, 7. *S. Aust. Nat.*, 14 (3): 72-108, pls. 1-4.

CRAWFORD, T., 1965. Some molluscs associated with *Posidonia* weed at Flinders, Victoria. *Aust. Newsletter (Malac. Soc. Aust.)*, 13 (no. 50): 13-14.

DAKIN, W., 1952. *Australian Seashores.* Angas and Robertson, Sydney. xii + 372 pp. 99 pls.

EALES, N., 1960. Revision of the world species of *Aplysia. Bull. Brit. Mus. (Nat. Hist.)*, 5 (10): 267-404.

ELIOT, C., 1903. On some nudibranchs from East Africa and Zanzibar, III. *Proc. Zool. Soc. Lond.*, 1903: 354-385, pls. 32-34.

———, 1906a. Report upon a collection of Nudibranchiata from the Cape Verd Islands. *Proc. Malac. Soc. Lond.*, 7: 131-159, pl. 14.

———, 1906b. On the nudibranchs of southern India and Ceylon, etc., II. *Proc. Zool. Soc. Lond.*, 1906: 636-691, 999-1008, pls. 42-47.

————, 1907. Nudibranchs from New Zealand and the Falkland Islands. *Proc. Malac. Soc. Lond.*, 7: 327-361, pl. 28.

————, 1908. Notes on a collection of nudibranchs from the Red Sea. *J. Linn. Soc. L⁻nd.*, Zool. 31: 86-122.

————, 1910. Nudibranchs . . . . from the Indian Ocean, etc. *Trans. Linn. Soc. Lond.*, Zool. 13 (3): 411-438, pl. 25.

————, 1913. Japanese Nudibranchs. *J. Coll. Sci. Tokyo Univ.*, 35 (1): 1-47, pls. 1-2.

GATLIFF, J. and C. GABRIEL, 1908. Additions to and revision of the catalogue of Victorian marine Mollusca. *Proc. R. Soc. Vict.*, (n. s.) 21 (1): 368-391, pl. 21.

————, 1909. Additions to the catalogue of marine shells of Victoria. *Ibid.*, (n. s.) 22 (1): 37-46.

————, 1911. On some new species of Victorian marine Mollusca. *Ibid.*, (n. s.) 24 (1): 187-192, pls. 46-47.

HABE, T., 1952. Atyidae in Japan. *Ill. Cat. Jap. Shells*, no. 20: 137-152, pls. 20-21.

HEDLEY, C., 1895. On a molluscan genus new to, and another forgotten from Australia. *Proc. R. Soc. Vict.*, (n. s.) 7: 197-200, pl. 11.

————, 1912. Descriptions of some new or noteworthy shells in the Australian Museum. *Rec. Aust. Mus.*, 8: 131-160, pls. 40-45.

HEDLEY, C. and W. MAY, 1908. Mollusca from one hundred fathoms, seven miles east of Cape Pillar, Tasmania. *Ibid.*, 7: 108-125, pls. 22-25.

HODGKIN, E., G. KENDRICK, L. MARSH and S. SLACK-SMITH, 1966. *The Shelled Gastropoda of South Western Australia.* Handbook No. 9., W. Aust. Nat. Club, Perth. 60 pp., 21 pls.

IREDALE, T., 1924. Results of Roy Bell's molluscan collections. *Proc. Linn Soc. N.S.W.*, 49: 179-278, pls. 33-34.

IREDALE, T. and D. McMICHAEL, 1962. A reference list of the marine Mollusca of New South Wales. *Mem. Aust. Mus.*, 11: 1-109.

MacFARLAND, F., 1905. A preliminary account of the Dorididae of Monterey Bay, California. *Proc. Biol. Soc. Washington*, 18: 35-54.

————, 1966. Studies of opisthobranchiate mollusks of the Pacific coast of North America. *Mem. California Acad. Sci.*, 6: xvi + 546 pp., 72 pls.

MACNAE, W., 1958. The families Polyceridae and Goniodorididae in southern Africa. *Trans. R. Soc. S. Africa.*, 35 (4): 341-372, pls. 17-18.

MACPHERSON, J. and C. GABRIEL, 1962. *Marine Molluscs of Victoria.* Melbourne University Press, Melbourne. xv + 475 pp., 486 figs.

MARCUS, E. (or E. and E.), 1958. On western Atlantic opithobranchiate gastropods. *Amer. Mus. Novitates*, no. 1906: 1-82.

————, 1961. Opisthobranch mollusks from California. *Veliger*, 3 (Suppl. 1): 1-85, pls. 1-10.

————, 1962. Opisthobranchs from Florida and the Virgin Islands. *Bull. Mar. Sci. Gulf and Carib.*, 12 (3): 450-488.

————, 1966. Opisthobranchs from tropical west Africa. *Stud. Trop. Oceanogr. Miami*, 4 (1): 152-208.

————, 1967a. American opisthobranch mollusks. I, Tropical American opisthobranchs. *Ibid.*, 6: 1-137, pl. 1.

————, 1967b. Ibidem. II, Opisthobranchs from the Gulf of California. *Ibid.*, 6: 140-248.

MARCUS, E. and J. BURCH, 1965. Marine euthyneuran Gastropoda from Eniwetok Atoll, Western Pacific. *Malacologia*, 3 (2): 235-262.

MAY, W., 1921. *A Check-list of the Mollusca of Tasmania.* Government Printer, Tasmania. 114 pp.

————, 1923. *An Illustrated Index of the Tasmanian Shells.* Government Printer, Tasmania. 100 pp., 47 pls.

MILLER, M. and W. RUDMAN, 1968. Two new genera and species of Runcinoidea from New Zealand. *Trans. R. Soc. N.Z.*, Zool. 10 (19): 183-189.

ODHNER, N., 1926. Die Opisthobranchien. *Further Zool. Res. Swed. Antarct. Exp. 1901-03*, 2 (1):1-100, pls. 1-3.

————, 1939. Opisthobranchiate Mollusca from the western and northern coasts of Norway. *K. Norske Vidensk. Selsk. Skr.*, 1939 (1): 1-93.

O'DONOGHUE, C., 1929. Opisthobranchiate Mollusca collected by the South African marine biological survey. *Un. S. Afr. Mar. Biol. Survey*, Rep. no.7: 84 pp., 8 pls.

PILSBRY, H., 1893-95. *Manual of Conchology*, 15: 436 pp., 61 pls.

————, 1895-96. *Ibid.*, 16: vii + 262 pp., 75 pls.

PRITCHARD, G. and J. GATLIFF, 1903. Catalogue of the marine shells of Victoria. *Proc. R. Soc. Vict.*, (n. s.) 15 (2): 176-223.

PRUVOT-FOL, A., 1934. Les opisthobranches de Quoy et Gaimard. *Arch. Mus. Hist. Nat. Paris*, (6), 11: 13-92, pl. 1.

————, 1953. Etudes de quelques opisthobranches de la cote Atlantique du Marco et du Senegal. *Trav. Inst. Cherif.*, 5: 1-105, pls. 1-3.

————, 1954. Mollusques opisthobranches. *Faune Fr.*, 58: 460 pp., 1 pl. Paul Lechevalier, Paris.

QUOY, J. and J. GAIMARD, 1832. *Voyage de decouvertes de l'Astrolabe*, etc. Zool. 2. Paris.

RISBEC, J., 1928. Contributions a l'etude des nudibranches Neo-Caledoniens. Faune Colon. Franc., 2 (1): 1-328, pls. A-D, 1-12.

————, 1956. Nudibranches du Viet-Nam. *Arch. Mus. Hist. Nat. Paris*, (7), 4: 1-34, pl. 1-22.

RUDMAN, W., 1968. Three new species of the opisthobranch family Aglajidae from New Zealand. *Trans. R. Soc. N.Z.*, Zool. 10 (23): 211-216.

SMITH, E., 1872. Remarks on several species of Bullidae, etc. *Ann. Mag. Nat. Hist.*, (4), 9: 344-355.

————, 1884. Mollusca. In: *Report on the Zoological Collections made in the Indo-Pacific Ocean during the voyage of H.M.S. 'Alert', 1881-2*. Pp. 34-116, pls. 1-7.

SOWERBY, G., 1869. *Aplysia*. In: *Conchologica Iconica* (By A. L. Reeve), 17: plates 1-10.

STIMPSON, W., 1855. Descriptions of some of the new marine Invertebrata from the Chinese and Japanese Seas. *Proc. Acad. Nat. Sci. Philad.*, 7: 375-380.

SUTER, H., 1913. *Manual of New Zealand Mollusca*. Wellington, New Zealand. 1120 pp., 72 pls. (1915).

TATE, R., 1889. Descriptions of some new species of marine Mollusca from South Australia and Victoria. *Trans. R. Soc. S. Aust.*, 11: 60-66, pl. 11.

TATE, R. and W. MAY, 1901. A revised census of the marine Mollusca of Tasmania. *Proc. Linn. Soc. N.S.W.*, 26 (3)· 344-471, pls. 23-27.

THIELE, J., 1931. *Handbuch der systematischen Weichtierkunde*, I Gustav Fischer, Jena. vi + 778 pp.

TOKIOKA, T. and K. BABA, 1964. Four new species and a new genus of the family Gastropteridae from Japan. *Publs Seto Mar. Biol. Lab.*, 12 (3): 201-229, pls. 10-13.

VAYSSIERE, A., 1888. Recherches . . . . opisthobranches du Golfe de Marseille. 2, Nudibranches et Ascoglosses. *Ann. Mus. Hist. Nat. Marseille*, Zool. 3 (4): 1-160, pls. 1-7.

VERCO, J., 1909. Notes on South Australian Mollusca with descriptions of new species, X. *Trans. R. Soc. S. Aust.*, 33: 270-276, pls. 20-21.

WATSON, R., 1886. Report on the Gasteropoda and Scaphopoda. *Rep. Res. Challenger*, Zool. 15: v + 756, 50 pls.